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Quantitative Feed Restriction Effects on Performance and Heamatological Traits of White Cockerels

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Abstract

This study investigated the effects of skip-a-day feeding regimens on growth performance and hematological parameters in white cockerels. Eighty-four day-old white cockerel chicks were randomly assigned to four dietary treatments: T1 (control), T2 (skip-a-day feeding from 6th week), T3 (skip-a-day feeding from 8th week), and T4 (skip-a-day feeding from 10th week). Growth performance was evaluated at 8, 10, 12, 14, and 16 weeks, while hematological parameters were assessed at 16 weeks. Results showed that skip-a-day feeding regimens significantly ($P<0.05$) affected growth performance, with T2 and T4 exhibiting superior weight gain and feed efficiency. However, hematological parameters remained largely unaffected ($P>0.05$), with the exception of white blood cell counts, which differed significantly among treatments. These findings suggest that skip-a-day feeding regimens can be an effective strategy to enhance growth performance in white cockerels, without compromising their hematological health. The study provides valuable insights into the effects of feed restriction on poultry growth and health, and highlights the importance of optimizing feeding protocols to achieve optimal productivity and welfare outcomes.

Keywords: Cockerels; Feeding regimens; Growth performance; Hematological parameters; Feed restriction

Introduction

Feed restriction, defined as the controlled reduction of feed intake below ad libitum levels, has been implemented in poultry production systems to manipulate growth patterns and improve feed efficiency. Several studies have investigated the effects of feed restriction on the performance of white cockerels, documenting both beneficial and detrimental outcomes. For instance, research by Zubair and Leeson [1] demonstrated that moderate feed restriction during specific growth phases could enhance feed efficiency and carcass characteristics in broiler chickens, which share genetic similarities with white cockerels. Similarly, findings by De Jong *et al.* [2] indicated that controlled feed restriction in broilers could result in improved feed conversion ratios and reduced production costs, suggesting its potential as a management tool in commercial settings.

However, the effects of feed restriction on hematological parameters in white cockerels remain a subject of debate and investigation. Hematological indices, such as red blood cell count, hemoglobin concentration, and hematocrit levels, serve as crucial indicators of physiological health and stress response in poultry. While some studies have reported no significant alterations in hematological profiles following feed restriction [3], others have observed changes indicative of physiological stress and metabolic adaptation [4]. These conflicting findings underscore the complexity of the relationship between feed restriction and hematological parameters in white cockerels, necessitating further research to elucidate underlying mechanisms and optimize management practices.

Moreover, the duration and intensity of feed restriction regimens are critical factors influencing their effects on white cockerels. Short-term or intermittent feed restriction may elicit different physiological responses compared to prolonged or severe restriction protocols. For instance, intermittent fasting has been proposed as a potential strategy to enhance metabolic health and longevity in various animal models, including poultry [5]. Therefore, tailored feed restriction protocols must consider the specific requirements and physiological responses of white cockerels to optimize both performance and welfare outcomes.

Feed restriction represents a versatile management tool with profound implications for the performance and hematological parameters of white cockerels in poultry production systems. While moderate restriction regimens may enhance feed efficiency and carcass quality, their effects on hematological indices warrant careful consideration to ensure animal welfare and productivity. Continued research endeavours are essential to elucidate the underlying mechanisms and refine feed restriction protocols tailored to the unique requirements of white cockerels in commercial settings.

Materials and Methods

Study Location and Preparation This study was conducted at the Poultry Unit of the Teaching and Research Farm, Faculty of Agricultural Sciences, Ekiti State University, Nigeria. Prior to the commencement of the experiment, the site underwent thorough

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cleaning, disinfection, and fumigation to eliminate potential pathogens and ensure biosecurity.

Experimental Birds and Management Eighty-four day-old white cockerel chicks were procured from a reputable hatchery. Upon arrival, the chicks were housed in a pre-heated environment and administered multivitamins along with prophylactic antibacterial drugs. Routine vaccinations and medications were provided against Newcastle disease, Marek's disease, Gumboro disease, and fowlpox. Veterinary drugs and vaccines were sourced from a reputable store in Ado-Ekiti, Nigeria. The birds were fed a commercial growers' mash formulated to meet standard nutritional requirements.

Experimental Design and Treatments

The experiment was conducted using a Completely Randomized Design (CRD). After a seven-day brooding period, the chicks were randomly assigned to four dietary treatments, each replicated three times. The treatment groups were as follows:

T1 (Control): Birds were fed ad libitum throughout the study period.

T2: Birds were subjected to a skip-a-day feeding regimen from the sixth week, followed by full feeding.

T3: Birds were subjected to a skip-a-day feeding regimen from the eighth week, followed by full feeding.

T4: Birds were subjected to a skip-a-day feeding regimen from the tenth week, followed by full feeding.

Data Collection and Measurements

Body weight was measured using a digital weighing scale. Initial weights were recorded upon arrival, and subsequent body weights were measured weekly throughout the experimental period. Feed intake was monitored daily. Hematological parameters assessed included packed cell volume (PCV), hemoglobin (Hb) concentration, red blood cell (RBC) count, white blood cell (WBC) count, platelet count, lymphocyte count, heterophil count, monocyte count, and eosinophil count. Blood samples were collected via venipuncture for hematological analysis.

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using SPSS statistical software. Treatment means were separated using Duncan's Multiple Range Test at a significance level of $P<0.05$.

Results

Performance Characteristics of White Cockerels Under Skip-A-Day Feeding Regime

The growth performance of broilers was evaluated at various ages, including 8, 10, 12, 14, and 16 weeks as shown in Table 1. At 8 weeks, significant differences ($P<0.05$) were observed in initial body weight, final body weight, and weight gain among treatments.

Specifically, T2 had the lowest initial body weight, while T1, T3, and T4 were statistically similar ($P>0.05$). Final body weight was lower in T3 compared to T1 and T4 ($P<0.05$), with T2 being intermediate. Weight gain was highest in T2 and T4 ($P<0.05$), while T3 had the lowest value. Feed intake was identical across treatments ($P>0.05$), but feed conversion ratio was significantly higher in T3 ($P<0.05$).

At 10 weeks, initial body weight differed significantly among treatments ($P<0.05$), with T3 being lower than T1 and T4, and T2

Table 1: Performance characteristics of white cockerels at different ages under skip-a- day feeding regime.

Age (weeks)	Parameters	T1 (Mean ± SEM)	T2 (Mean ± SEM)	T3 (Mean ± SEM)	T4 (Mean ± SEM)
8	IBW (g)	299.00 ± 12.72^{a}	254.33 ± 8.80^{b}	298.92 ± 9.59^{a}	324.09 ± 11.74^{a}
	FBW (g)	520.45 ± 11.59^{a}	504.17 ± 21.28^{ab}	454.17 ± 19.90^{b}	547.27 ± 16.40^{a}
	WG (g)	212.36 ± 17.66^{ab}	249.83 ± 24.25^{a}	154.75 ± 24.06^{b}	222.91 ± 22.04^{a}
	FI (g)	280.00 ± 0.00	280.00 ± 0.00	280.00 ± 0.00	280.00 ± 0.00
	FCR	1.32 ± 0.02^{b}	1.12 ± 0.02^{b}	1.81 ± 0.17^{a}	1.27 ± 0.01^{b}
10	IBW (g)	505.56 ± 13.68^{a}	497.22 ± 25.50^{ab}	431.25 ± 26.62^{b}	517.50 ± 11.82^{a}
	FBW (g)	613.89 ± 21.70^{ab}	655.56 ± 22.74^{a}	575.00 ± 25.00^{b}	612.50 ± 31.46^{b}
	WG (g)	108.33 ± 30.33^{c}	152.78 ± 21.83^{a}	143.75 ± 30.53^{b}	95.00 ± 35.71^{d}
	FI (g)	350.00 ± 0.00	350.00 ± 0.00	350.00 ± 0.00	350.00 ± 0.00
	FCR	3.23 ± 0.24	2.29 ± 0.05	2.43 ± 0.14	3.68 ± 0.18
12	IBW (g)	553.13 ± 22.34^{ab}	616.67 ± 38.00^{a}	495.00 ± 24.10^{b}	522.22 ± 22.22^{b}
	FBW (g)	718.75 ± 28.25^{b}	825.00 ± 21.41^{a}	725.00 ± 22.67^{b}	711.11 ± 29.79^{b}
	WG (g)	165.63 ± 16.99^{d}	208.33 ± 30.05^{b}	230.00 ± 29.06^{a}	188.89 ± 26.06^{c}
	FI (g)	455.00 ± 0.00	455.00 ± 0.00	455.00 ± 0.00	455.00 ± 0.00
	FCR	2.75 ± 0.04	2.18 ± 0.07	1.98 ± 0.05	2.41 ± 0.11
14	IBW (g)	695.69 ± 25.63	711.11 ± 46.23	692.31 ± 23.24	715.50 ± 32.39
	FBW (g)	890.91 ± 31.49	955.56 ± 35.79	896.15 ± 22.26	975.00 ± 37.80
	WG (g)	204.55 ± 33.34	255.56 ± 67.77	203.85 ± 20.77	268.75 ± 32.65
	FI (g)	511.00 ± 0.00	511.00 ± 0.00	511.00 ± 0.00	511.00 ± 0.00
	FCR	1.78 ± 0.11	1.43 ± 0.14	1.79 ± 0.05	1.36 ± 0.04
16	IBW (g)	866.67 ± 33.33	887.50 ± 36.29	892.22 ± 18.84	887.50 ± 47.01
	FBW (g)	1140.67 ± 42.78^{ab}	1156.13 ± 36.63^{a}	1077.22 ± 19.63^{ab}	1042.13 ± 41.63^{b}
	WG (g)	262.89 ± 57.49	268.63 ± 29.66	205.00 ± 28.51	154.63 ± 36.45
	FI (g)	700.00 ± 0.00	700.00 ± 0.00	700.00 ± 0.00	700.00 ± 0.00
	FCR	2.66 ± 0.10^{b}	2.61 ± 0.04^{b}	3.41 ± 0.10^{b}	4.51 ± 0.44^{a}

^{a,b,c,d} indicate significant differences (p<0.05) in means within rows.
IBW: Initial Body Weight; **FBW**: Final Body Weight; **WG**: Weight Gain; **FI**: Feed Intake; **FCR**: Feed Conversion Ratio.

Table 2: Heamatological characteristics of white cockerels at 16 weeks of age under skip-a-day feeding regime.

Parameters	T1	T2	T3	T4	SEM
Packed cell volume	24.00±4.73	24.00±1.73	23.67±1.20	25.33±1.45	1.16
Haemoglobin	7.70±1.72	8.07±0.58	7.67±0.48	8.30±0.59	0.43
Red blood cell	2.28±0.70	2.3967±0.52	1.70±0.34	2.33±0.56	0.25
White blood cell	10368.33±43931.58[c]	15616.67±204.80[a]	14500.00±556.78[b]	15283.33±544.93[a]	14880.39
Platelet	184333.33±28309.79	147666.67±4841.95	171333.33±20341.53	152333.33±16954.19	9441.57
Lymphocyte	65.67±3.38	59.00±5.51	63.33±2.03	57.67±3.67	1.91
Heterophil	25.67±3.76	34.67±7.22	28.33±2.33	35.33±3.71	2.33
Monocyte	4.33±1.20	2.33±0.88	2.33±0.33	3.67±0.33	0.42
Eosinophil	4.64±1.20	3.33±1.20	4.67±2.03	3.33±0.67	0.62

[a,b] = means along the same row with different superscripts differ significantly (p<0.05).

being intermediate. Final body weight and weight gain also showed significant variation (P<0.05), with T2 having the highest final body weight and weight gain, followed by T3. Feed intake remained constant across treatments (P>0.05), and feed conversion ratio did not show significant differences (P>0.05).

At 12 weeks, initial body weight varied significantly (P<0.05) among treatments, with T2 recording the highest value, and T3 and T4 having the lowest. Final body weight and weight gain followed a similar trend, with T2 being greater than all other treatments. Feed intake remained unchanged across treatments (P>0.05), but feed conversion ratio was significantly (P<0.05) lower in T3. At 14 weeks, initial and final body weights, weight gain, and feed conversion ratio did not differ significantly (P>0.05) among treatments. At 16 weeks, final body weight showed significant variation (P<0.05) among treatments, with T4 being lower than T2, while T1 and T3 were intermediate. Feed conversion ratio was significantly highest in T4 (P<0.05).

Haematological Characteristics of White Cockerels at 16 Weeks of Age Under Skip-A- Day Feeding Regime

Table 2 presents the results on heamatological characteristics of white cockerels at 16 weeks of age under skip-a-day feeding regime. Results indicated that all the haematological parameters investigated which include the packed cell volume (PVC), haemoglobin (HB) concentration, red blood cell (RBC) counts, blood platelet counts, lymphocyte count, heterophil, monocytes and eosinophil counts in all the Treatment were similar (p>0.05). However, white blood cell (WBC) counts are similar between treatments 2 and 4, differences (p<0.05) are obtained between treatment 1 and each of the other treatments and between treatment 3 and each of treatments 1, 2 and 4.

Discussion

The findings of this study provide valuable insights into the effects of skip-a-day feeding regimens on broiler growth performance, particularly in relation to the timing of feed restriction. One of the most striking observations is the superior performance of T2, where birds were subjected to a skip-a-day feeding regimen from the sixth week, followed by full feeding. This treatment consistently resulted in higher final body weights and weight gains, particularly at 10 and 12 weeks. This outcome can be attributed to the phenomenon of compensatory growth, which has been extensively documented in poultry science. Compensatory growth occurs when birds undergo a period of restricted feeding followed by *ad libitum* access to feed, leading to accelerated growth rates that partially or fully compensate for the earlier deficit [6]. Studies, such as those by Al-Murrani [7] and Akinsola *et al.* [8], further corroborate this phenomenon, emphasizing the role of early feed restriction in enhancing growth performance and feed efficiency.

The timing of feed restriction appears to be critical, as early restriction (as in T2) allows sufficient time for metabolic adaptations and subsequent compensatory growth. This is consistent with the findings of Almeida *et al.* [6], who reported that early feed restriction (up to 4 weeks of age) enhances feed efficiency and overall growth performance in broilers. Somaia [9] highlights that early feed restriction not only improves growth metrics but also reduces the incidence of metabolic disorders, such as ascites and skeletal abnormalities, which are common in fast-growing broiler strains. Mohamed [10] reinforces these conclusions, demonstrating that early skip-a-day feeding improves not just growth outcomes but also carcass quality.

In contrast, the poorer performance of T3 and T4, where feed restriction was initiated at the eighth and tenth weeks, respectively, underscores the importance of timing in skip-a-day feeding regimens. T3, in particular, exhibited the lowest weight gain and highest feed conversion ratio (FCR) at 8 weeks, suggesting that feed restriction during this critical growth phase may impair growth potential. This aligns with the findings of Gobane *et al.* [11], who reported that late feed restriction (after 6 weeks) does not yield significant compensatory growth, as the birds may not have sufficient time to recover from the growth deficit. Similarly, the poor performance of T4 at 16 weeks, characterized by lower final body weight and higher FCR, further supports the notion that late feed restriction is less effective in promoting optimal growth. Oyedeji *et al.* [12] also observed that late feed restriction strategies often fail to achieve the desired economic and growth outcomes, emphasizing the need for precise timing. Furthermore, Akinsola *et al.* [8] noted that genetic variations among broiler strains could influence the degree to which late feed restriction impacts growth performance.

The lack of significant differences in feed intake across treatments is an interesting finding, as it suggests that skip-a-day feeding does not necessarily reduce overall feed consumption but rather influences how efficiently the feed is utilized for growth. This is particularly evident in the case of T2, which achieved higher weight gains despite similar feed intake levels. This could be attributed to metabolic adaptations during the restriction period, such as reduced maintenance energy requirements and improved nutrient utilization, as proposed by Almeida *et al.* [6]. These adaptations may enable birds to allocate more energy toward growth once full feeding is resumed. Recent findings by Oyedeji *et al.* and Mohamed [10,12] suggest that these metabolic adjustments also result in improved carcass characteristics, such as increased breast muscle yield and reduced fat deposition.

The variations in FCR across treatments further highlight the impact of feed restriction timing on feed efficiency. For instance, T3 exhibited the lowest FCR at 12 weeks, indicating improved feed efficiency during this period. This may be due to the metabolic adjustments that occur during feed restriction, which enhance the ability of the bird to utilize nutrients more effectively. However, the higher FCR observed in T3 at 8 weeks and in T4 at 16 weeks suggests that the benefits of these metabolic adaptations may be short-lived or dependent on the timing of restriction. Alkhair [13] also noted that while early feed restriction can lead to sustained improvements in feed efficiency, late restriction often results in transient benefits that do not translate into long-term growth advantages.

The findings of this study are consistent with recent research on feed restriction strategies in broilers. For example, a study by Almeida *et al.* [6] demonstrated that early feed restriction improves growth performance and feed efficiency, while late restriction has minimal benefits. Similarly, Al-Murrani [7] found that skip-a-day feeding initiated during the early growth phase promotes compensatory growth and enhances overall productivity. Oyedeji *et al.* [12] further emphasized the economic advantages of early feed restriction, noting its potential to reduce production costs without compromising growth performance. Akinsola *et al.* [8] highlighted the need to consider genetic differences among broiler strains when designing feed restriction programs, as this can impact the efficacy of the strategy.

The absence of significant differences in most hematological parameters, including packed cell volume (PCV), hemoglobin (HB) concentration, red blood cell (RBC) counts, blood platelet counts, and differential leukocyte counts (lymphocytes, heterophils, monocytes, and eosinophils), suggests that the skip-a-day feeding regime did not impose significant stress or nutritional deficiencies severe enough to alter these parameters. This finding aligns with previous studies that have demonstrated the resilience of poultry to intermittent feeding, particularly when the overall nutritional requirements are met over time [14,15].

The stability in PCV, HB, and RBC counts across treatments indicates that the oxygen-carrying capacity and overall erythrocyte health were maintained, which is critical for metabolic efficiency and growth in poultry. This is consistent with the findings of Adeyemi *et al.* [16], who reported that intermittent feeding regimes did not adversely affect erythrocyte parameters in broiler chickens, provided that the birds had access to adequate nutrients during feeding periods. The lack of significant changes in platelet counts further suggests that the skip-a-day feeding regime did not induce thrombocytopenia or other coagulation-related issues, which could otherwise compromise the health of the birds [17].

The significant differences between treatment 1 and the other treatments, as well as between treatment 3 and treatments 1, 2, and 4, in white blood cell counts suggest that specific feeding protocols or nutritional compositions in these treatments may have influenced the immune response. WBC counts are a key indicator of immune status, and variations in these counts can reflect differences in stress levels, disease resistance, or inflammatory responses [18]. The similarity in WBC counts between treatments 2 and 4 implies that these treatments may have provided a more balanced nutritional or physiological environment, minimizing immune activation. This finding is supported by the work of Zhang *et al.* [19], who found that specific dietary interventions could modulate WBC counts in poultry, particularly under stress-inducing conditions such as intermittent feeding.

The differential response in WBC counts across treatments could also be attributed to variations in the ability of the birds to adapt to the skip-a-day feeding regime. For instance, treatment 1 may have imposed a greater physiological challenge, leading to an elevated immune response, as evidenced by higher WBC counts. This is consistent with the findings of Aluwong *et al.* [20], who reported that certain feeding regimes could induce mild stress, thereby activating the immune system. Conversely, the lower WBC counts in treatments 2 and 4 suggest that these regimes were better tolerated, possibly due to optimized nutrient delivery or reduced stress levels.

When compared to other studies, the results of this investigation are largely consistent with the broader literature on intermittent feeding in poultry. For example, a study by Hassan *et al.* [21] found no significant differences in hematological parameters, including PCV, HB, and RBC counts, in broilers subjected to skip-a-day feeding, further supporting the resilience of poultry to such regimes. However, the observed differences in WBC counts highlight the need for further research into the specific dietary and management factors that influence immune responses under intermittent feeding conditions. This is particularly relevant given the growing interest in alternative feeding strategies to improve poultry welfare and production efficiency [22-27].

Conclusion

The findings of this study provide valuable insights into the effects of skip-a-day feeding regimens on broiler growth performance and hematological parameters. Early feed restriction optimizes growth, while late restriction hinders growth potential. Skip-a-day feeding regimes appear physiologically tolerable with minimal alterations to hematological parameters.

Recommendation

Poultry producers should consider implementing early feed restriction strategies, such as skip-a-day feeding, to enhance growth performance and feed efficiency. Careful monitoring of hematological parameters, particularly WBC counts, is essential to ensure broiler health and well-being.

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