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Comparison of strains and feed withdrawal durations on growth, haematological indices and serum biochemistry of broiler chickens at finisher phase

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Target audience: *Researchers, farmers, consumers.*

Abstract

The present investigation was undertaken to assess the response of two broiler strains in terms of growth, haematological and serum indices to different durations of feed withdrawal regimen at finisher phase. A total of 180 day-old broiler chicks comprising 90 chicks each of Arbor Acre and Ross 308 were sourced from reputable hatchery. The chicks on strain basis were distributed into three feed withdrawal durations: T_1 (control), T_2- morning (8am-12noon) and T_3- afternoon (12noon – 4pm). Each of the treatment was replicated three times. Results showed the existence of significant ($P<0.01$) differences between the two strains in respect of body weight and linear measurements at 4^{th} and 6^{th} week. Ross 308 broilers in most cases recorded superior mean values than Arbor Acre. It means that the former has superior genetic make-up than the latter. Feed withdrawal durations also had significant effects on body weight and linear measurements. Full-fed birds had superior mean values than morning and afternoon fed birds in most of the traits measured. However, morning and afternoon fed birds recorded similar mean values. In addition, there was no significant ($P>0.05$) effect of strain and feed withdrawal on haematological and serum indices except total protein, cholesterol, creatinine and albumin. The obtained haematological mean values were within the recommended range, and this implies that birds reared under feed withdrawal regimen are safe and healthful for human consumption.

Key words: *Strain, Arbor Acre, Ross 308, Haematology, feed.*

Description of Problem

For the rapidly increasing human population in Nigeria, broiler production has a major role to play in ensuring food security, and this can be attributed to their short production cycle, high feed efficiency and growth rate. Body weight is the most frequently used indicator of growth (1). It is a quantitative trait, controlled by few pairs of genes, highly heritable and also influenced by the environment. Previous studies had reported that differences in growth pattern are under genetic control, and that variations exist within species (2), and between strains (3). In addition, significant effect of strain and sexes on body weight and body dimensions were reported by (4). Similar findings were documented in earlier studies on broiler chickens (5,6,7).

The success of any broiler production depends not only on the strain of the birds, but also on management, housing, quality and quantity of feeds given, health status and market forces. Feed constitutes 60% of the total cost of production in a broiler enterprise, and whatever method to reduce this high input

component should be considered for the good of the farmers and overall interest of the industry (8). Feed restriction in broilers can help improve feed efficiency, reduce feed cost and mortality in addition to producing chicken meat at affordable price (9).

It was further reported in literature that feed restriction reduced chances of metabolic disorders like ascities syndrome which are common with broiler production resulting in high mortality thereby making the enterprise unprofitable (10). There are different methods of feed restriction employed in broiler production to improve efficiency of feed utilization and weight gain, and these include intermittent feeding, skip-a-day feeding (11), appetite suppression with glycolic acid (12), time of restriction (13), diet dilution (14) and quantitative feed restriction (15).

Haematological and serum indices over the years have been used as indicators of health and physiological state of domestic animals. Haematology indices such as haemoglobin, red blood cells, white blood cells or leucocytes, their derivatives mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration are valuables in monitoring both the nutritive value and toxicity of feed especially with feed constituents that affect the blood as well as the health status of farm animals. Packed Cell Volume (PCV) is expressed as a percentage of blood cell, and it determines the percentage of red blood cell in the whole blood volume. It is affected by sex, age, time of day and hormones. The white blood cells or leucocytes are cells in the immune system involved in defending the body against both infectious diseases and foreign materials by a process called phagocytosis. There are different types of white blood cell which includes neutrophils, eosinophils, basophils, monocytes and lymphocytes (16).

Serum biochemistry refers to the chemical analysis of serum, can include many different tests, each of which provides information about one or more organs in the body. If a test result is abnormal, it indicates that disease is present. Further assessment of the test results may provide information about the nature and severity of the problem (17).

This research work was undertaken to determine the influence of strain of broiler chickens and duration of feed withdrawal regimen on body weight, body linear measurements, haematological and serum indices. The research aimed at the response of broiler chickens to changes in diurnal temperature.

Materials and Methods

This study was carried out at the Poultry Unit, Teaching and Research farm, Department of Animal Production, Kogi State University, Anyigba. Anyigba is located in the Derived Savannah zone of Nigeria on latitude 7°15 and 7°29N of the equator and longitude 7°11 and 7°32E of the Greenwich meridian with an average altitude of 420m above sea level. The zone is characterized by 6-7 months of annual rainfall ranging from 1400-1500mm and daily temperature range of 25°C-35°C with highest temperature being in June-July (18).

Source of experimental birds and feed

A total of 180 day-old broiler chicks of two strains comprising of Arbor Acre and Ross 308 (90 chicks each) were procured to examine and compare growth traits, haematological and serum indices of two broiler strains subjected to different feed withdrawal periods. The birds were raised on deep litter with the floor covered (2-3cm) with wood shavings partitioned into two different units where both strains were raised separately in the brooding room. Feed and water were provided before the arrival of the chicks and chicks were brooded using kerosene stove and charcoal as the source of heat. The chicks were brooded for 4 weeks and were fed *ad libitum* using

starter feeds having 3000 Kcal MEkg^{-1} , 22% CP. Vaccination and other routine medications were carried out as and when due. At the fourth to seventh week, the birds were given finisher feeds having 3100 KcalMEkg^{-1}, 19.5% CP. The brooded birds were distributed into three treatments with three replicates for each strain. Water was given *ad libitum* throughout the time of the experiment.

The treatments applied are as follows:

T_1 = Control (*ad libitum*), **T_2** = Morning feeding (8am - 12noon- 4 hours/day)

T_3 = Afternoon feeding (12noon - 4pm- 4 hours/day)

Data collection

a. **Body weight (bw):** The body weight was measured in grams from 4th – 7th week of age using a digital electronic scale (with maximum calibration of 5,000g). The body weights were measured early in the morning after feed withdrawal for a few hours.

All these conformation traits were measured using a tape rule.

- Breast girth (BRG) was measured across the keel bones from the left armpit to the right armpit.
- Thigh length (THL) was taken from the hock joint to the hinge joint.
- The tarso-meta tarsus (shank length) (SHL) was obtained by measuring from the hock joint to the base of the three toes.
- Wing length (WNL) was measured from the shoulder joint to the extremity of terminal phalanx.

To ensure accuracy, each measurement was taken twice.

b. Haematological parameters

At the end of the 7th week (day 49) one bird per replicate was randomly chosen for blood collection (a total of 18 samples collected). The blood samples from the birds were collected using a new needle and syringe into a labelled sample bottles treated with Ethylene-diamine tetraacetic acid (anti-coagulant). Hematological parameters determined included packed cell volume (PCV), haemoglobin (HB), red blood cell (RBC) and white blood cell (WBC). Serum indices evaluated are total protein, creatinine, albumin, calcium and cholesterol.

Data Analysis

The data collected were analyzed by the analysis of variance technique in completely randomized design, while the differences between means were separated by Duncan New Multiple Range Test as per SAS (19).

The appropriate statistical model used was:

$Y_{ijk} = \mu + G_i + R_j + \varepsilon_{ijk}$

Y_{ijk} = observation on kth population, of ith strain and jth feed restriction

μ = common mean

G_i = fixed effect of strain (i=2)

R_j = fixed effect of feed withdrawal (j=3)

ε_{ijk} = error term

Results and Discussion

Table 1 shows the strain effect on growth characteristics of broiler chickens reared under different feed withdrawal regimen at finisher phase. There was a significant ($P<0.05$) effect of strain on body weight at 4th week. Ross 308 recorded higher mean value than Arbor Acre. However, body linear traits that were measured were not significantly ($P>0.05$) different between the strains except breast girth. In this case, Arbor Acre showed superiority over Ross 308. At 5th week, body weight was not significantly ($P>0.05$) different between the two strains. On body linear traits measured, only breast girth and thigh length were significant ($P<0.05$), while shank and wing length were not ($P>0.05$). Ross 308 recorded higher mean values in breast girth and thigh length.

Table 1: Least squares means showing the effect of strain on growth traits of broilers under feed withdrawal at finisher phase (4^{th} – 7^{th} week)

		Traits				
Strain	**Age (weeks)**	**BW (g)**	**BG (cm)**	**TL (cm)**	**SL (cm)**	**WL (cm)**
Arbor Acre	4^{th}	498.36^{b}±7.13	10.84^{a}±0.11	7.68±0.12	3.64±0.07	11.36±1.94
Ross308		561.86^{a}±7.13	9.76^{b}±0.11	7.89±0.12	3.70±0.07	14.25±1.94
Arbor Acre	5^{th}	824.14±8.60	14.45^{b}±0.09	9.52^{b}±0.07	4.36±0.03	13.98±0.09
Ross308		850.22±8.60	14.93^{a}±0.09	9.95^{a}±0.07	4.46±0.03	14.14±0.09
Arbor Acre	6^{th}	1120.92^{b}±10.36	21.97^{b}±0.14	12.11±0.11	5.92^{a}±0.17	15.56^{a}±0.05
Ross308		1256.89^{a}±10.36	24.92^{a}±0.14	12.25±0.11	5.21^{b}±0.17	14.97^{b}±0.05
Arbor Acre	7^{th}	1417.36±31.19	24.74±0.41	13.25±0.20	4.33±0.07	16.00^{b}±0.18
Ross308		1474.50±31.50	24.47±0.41	12.74±0.20	4.78±0.07	16.94^{a}±0.18

ab means with different superscripts along columns are significantly different (P<0.05)
BW- body weight, BG- breast girth, TL- thigh length, SL- shank length, WL- wing length

At 6^{th} week, Ross 308 recorded higher (P<0.05) mean values in body weight and breast girth, while Arbor Acre had superior (P<0.05) mean values in shank length and wing length. However, the two strains had similar (P>0.05) mean values in thigh length. At the end of the field trial, that is, 7^{th} week, the two strains were not significantly (p>0.05) different in body weight and body linear measured traits except wing length. On the final analysis, the response of the two strains to feed withdrawal regimen shows that Ross 308 in most cases during the period recorded superior mean values than Arbor Acre. It can be said the former has superior genetic make-up than the latter, and the result confirmed existence of strain differences in body weight and body linear measurements as reported by several authors (3,4).

Table 2 shows the effect of feed withdrawal periods on body weight and body linear measurements of broiler chickens regardless of strain of birds. At 4^{th} week, there was no significant (P>0.05) effect of feed withdrawal on body weight and all body linear measured traits except shank length. In this case, control birds had higher (P<0.05) mean value than morning and afternoon fed birds. At 5^{th} week, there was highly significant (P<0.01) effect of feed withdrawal periods on body weight and all body linear measured traits. Full fed birds recorded higher (P<0.05) mean values, intermediate mean values with morning fed birds, while the least mean values were reported for afternoon fed birds. In addition, 6^{th} and 7^{th} weeks witnessed similar scenario. That is, full-fed birds recorded superior mean values in body weight and other body linear measured traits than morning and afternoon fed birds. However, morning and afternoon fed birds had similar mean values. This implies that with good management practices, both morning and afternoon feeding strategies could be adopted for the production of live broilers in order to increase animal protein consumption. The obtained results infer that the broiler chickens regardless of strain were tolerant to both low and high temperature ranges of morning and afternoon periods, respectively.

Table 2: Least squares means showing the effect of feed withdrawal durations on growth traits of broiler chickens at finisher phase (4^{th} – 7^{th} week)

		Traits				
Treatments	**Age (weeks)**	**BW (g)**	**BG (cm)**	**TL (cm)**	**SL (cm)**	**WL (cm)**
T_1		517.67±8.73	10.46±0.13	8.25^{a}±0.15	3.90^{a}±0.09	11.38±2.37
T_2	4^{th}	532.50±8.73	10.11±0.13	7.54^{b}±0.15	3.52^{b}±0.09	11.38±2.37
T_3		540.17±8.73	10.34±0.13	7.57^{b}±0.15	3.59^{b}±0.09	15.67±2.37
T_1		915.08^{a}±10.53	15.29^{a}±0.11	10.50^{a}±0.09	4.54^{a}±0.04	14.61^{a}±0.11
T_2	5^{th}	820.04^{b}±10.53	14.58^{b}±0.11	9.67^{b}±0.09	4.30^{b}±0.04	13.88^{b}±0.11
T_3		783.92^{c}±10.53	14.19^{c}±0.11	9.02^{c}±0.09	4.40^{b}±0.04	13.69^{b}±0.11
T_1		1318.75^{a}±12.69	24.50^{a}±0.17	12.83^{a}±0.13	5.65±0.21	15.77^{a}±0.06
T_2	6^{th}	1094.25^{c}±12.69	22.88^{b}±0.17	11.90^{b}±0.13	5.75±0.21	14.92^{b}±0.06
T_3		1153.71^{b}±12.69	22.96^{b}±0.17	11.81^{b}±0.13	5.29±0.21	15.11^{b}±0.06
T_1		1558.83^{a}±38.21	24.71±0.50	13.06±0.24	4.67±0.08	16.88^{a}±0.22
T_2	7^{th}	1352.21^{b}±38.21	24.50±0.50	12.69±0.24	4.49±0.08	16.15^{b}±0.22
T_3		1426.75^{b}±38.21	24.61±0.50	13.23±0.24	4.50±0.08	16.44^{ab}±0.22

ab means with different superscripts along columns are significantly different (P<0.05)
BW- body weight; BG- breast girth; TL- thigh length; SL- shank length; WL- wing length
T_1- control; T_2- morning; T_3-afternoon

Table 3: Least squares means showing the effects of strain and feed withdrawal durations on haematological and serum indices

Strains	**PCV** (%)	**Wbc** (µl)	**Rbc** (x10^6µl)	**Hb** (g/dl)	**TP** (g/dl)	**Chol.** (mg/dl)	**Alb.** (g/dl)	**Ca** (mg/dl)	**Creat.** (mg/dl)
Arbor Acre	39.49	5.97	6.26	12.54	5.26	122.00	5.37	60.33^{b}	0.79
Ross 308	39.45	6.44	8.44	11.42	5.87	132.44	4.38	78.56^{a}	0.92
Sem (±)	1.28	0.46	0.85	0.73	0.36	10.57	0.32	3.43	0.08
Feed Withdrawal									
T1	38.58	6.05	6.72	10.83	4.58^{b}	131.50^{ab}	4.0^{b}	66.17	0.67^{b}
T2	39.53	7.11	7.46	11.91	5.43^{ab}	103.67^{b}	5.0^{ab}	73.50	0.87^{ab}
T3	40.31	5.45	7.88	13.20	6.67^{a}	146.50^{a}	5.68^{a}	68.67	1.02^{a}
Sem (±)	1.57	0.57	1.04	0.89	0.45	12.94	0.40	4.20	0.09

ab means with different superscripts along columns are significantly different (P<0.05)
PVC-Packed cell volume, WBC-White blood cell, RBC-Red blood cell, Hae-Haemoglobin, TP-Total protein, Chol-Cholesterol, Alb.-Albumin, Ca.-Calcium, Crea.-Creatinine
T_1- control; T_2- morning; T_3-afternoon.

Conclusions and Applications

1. The present study indicates existence of significant strain differences in growth traits of broiler chickens reared under feed withdrawal regimen. Ross 308 broiler chickens appeared superior to Arbor Acre in most of the traits measured.
2. With regard to feed withdrawal strategy, morning and afternoon fed birds were not significantly different in terms of body and linear measured traits. With conducive environment and good management practices, either approach can be adopted for increased broiler meat production.
3. The results of Haematological indices indicates no significant differences between the strains and feed withdrawal regimen. Also, the obtained haematological values indicate no negative impact or threat to the wellbeing of the birds because the values obtained fell within the normal range for birds.

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