Nig. J. Anim. Prod. 2018, 45(2): 88 - 95
Nigerian Journal of Animal Production

Effect of feed restriction period and strain on growth performance and haematological indices of pullet chicks

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Abstract

An eight weeks restricted feeding trial was conducted to investigate the effect of restricted feeding and strain on the growth performance and haematological parameters of two strains of pullet chicks. Five hundred and forty chicks comprising of Isa Brown (270) and Bovans Nera (270) strains were assigned to six treatments arranged in a 2 x 3 factorial arrangement of Isa Brown and Bovans Nera on ad libitum (R_0), skip-a-day (R_1) and skip-2-days (R_2) restrictions per week, respectively. Final live weight and weight gain of pullet chicks reduced ($P < 0.05$) with increasing level of feed restriction. Chicks on ad libitum showed improved ($P<0.05$) final live weight and weight gain. Results showed significant ($p<0.05$) reduction in feed intake and body weight of chicks due to restricted feeding. The birds maintained on R_0 feed restriction group recorded the highest significant ($p<0.05$) values of final body weight (544.57g), feed intake per day (33.70g/day) and daily weight gain (9.82g/day). R_1 birds recorded significantly ($p<0.05$) higher values of final weight, feed intake and weight gain when compared with R_2 birds with final body weight of 480.84g, daily feed intake of 28.42g/day and daily weight gain of 8.48g. Furthermore, Bovans Nera pullet chicks recorded significantly higher ($p<0.05$) final weight and daily weight gain when compared with the Isa Brown birds of same age. The R_2 pullets had significantly higher ($p<0.05$) white blood cells when compared with the R_0 and R_1 birds. Heterophil/lymphocyte ratio (0.52) was significantly ($p<0.05$) lower with the Isa brown birds.

Keywords: Restricted feeding, pullet chicks, growth performance, haematological parameters

Introduction

Poultry feeding without restriction has been reported to make birds become obese and thus predispose them to thermal discomfort, high incidence of lameness and mortality due to skeletal disorders and heart failure (Katanbaf *et al.*, 1989; Savory *et al.*, 1993). Excessive body weight in egg laying birds has been reported to be associated with reduced disease resistance (Han and Smyth, 1972; Hocking *et al.*, 1996) and increased incidence of multiple ovulations in females which results in lowered production of sellable eggs (Hocking, 1987; Hocking *et al.*, 1989) and poor egg shell quality (Robinson *et al.*, 1993). In view of this, feed restriction has been reportedly used to correct some of the above mentioned adverse consequences of *ad libitum* feeding (Gous and Stielase 1976; Summers and Robinson, 1995). Restricted feeding had been documented to improve net egg income over feed cost in both egg type and broiler breeder pullets (Mbugua and Cunningham, 1985). Restricted feeding is usually practiced in tropical countries as a means to force down the cost of production so that poultry farmers can break even over feed cost. Strain of bird, level of restriction and period at which feed restriction is

applied may influence the production indices of poultry birds (Summers and Robinson, 1995). Arbitrary restriction of the quantity of feed offered to commercial layers has however been reported to negatively affect the production potential of poultry farms (Ezieshi *et al.,* 2003). Information on feed restriction in layers in Nigeria is limited, though much work has been reported on restricted feeding in broilers, both in the temperate and tropical regions (Robbins *et al.*, 1986; Ibe and Nwachukwu, 1990; Yu *et al.*, 1992; Bruggeman *et al.,* 2005; Hocking and Robertson, 2005; Onagbesan *et al.*, 2006). This research is therefore designed to determine the effect that different restricted feeding levels at the chick and growing phases, will have on laying performances of two egg-type chicken strains.

Materials and methods

Experimental location

Experimental birds and management

A total of five hundred and forty (540) pullet chicks of two strains (270 Isa-Brown and 270 Bovans Nera) obtained from a commercial hatchery were allotted into18 pens, each pen of dimension 2.5m x 3m housed 30 pullet chicks. Chicks were assigned to six treatments arranged in a 2 x 3 factorial arrangement of both Isa Brown and Bovans Nera strains on *ad-libitum* (IR_0), skip-a-day (IR_1) and skip-2-days (IR_2) weekly. Brooding of chicks was done for 28 days while normal ambient temperature prevailed after brooding period. Chicks were fed with compounded chick diet (Table 1) for 0 - 56 days. Water was given *ad libitum* throughout the experimental period. Feed consumption and body weight were recorded on weekly basis while mortality was recorded as it occurred.

Table 1: Percentage Composition of Chicks Diets

Ingredients	Chick Starter
Maize	50.00
Fish Meal	2.50
Soybean Meal	12.00
Groundnut cake	9.80
Palm Kernel Cake	5.00
Wheat Offal	16.00
Bone Meal	2.00
Oyster Shell	2.00
Lysine	0.10
Methionine	0.10
Chick's Vit/Min eral Premix	0.25
Salt	0.25
Total	100.00
Determined Analysis (%)	
Crude Protein	19.02
Ether Extract	4.06
Crude Fibre	4.08
Ash	3.58
Calcium	1.39
Phosphorus	0.42
Lysine	0.96
Methionine	0.42
Energy (Kcal/Kg)	2,703.40

Vit./Min. Premix contained: Premix (Embavit No 90) contained Vit. A, 10 000 000iu; D3, 2 000 000; E, 12 500iu; K, 1.30; B2, 4.00g; D Calcium-Pantothenate, 1.30g; B6, 1.30g; B12, 0.01g; nicotinic acid, 15.00g; folic acid, 0.05g; biotin, 0.02g; Co, 0.20g; Cu, 5.00g; E, 25.00g; I, 0.06g; Mn, 48.00g; Se, 0.10g; Zn, 45.00g; Chlorine Chloride, 200.00g; BHT, 50.00g

Haematological indices

Blood samples (2 ml per bird) were obtained from two chicks per pen (n= 6 per treatment) by puncturing the brachial vein at 56th day of the study. Blood samples were collected into vials containing Ethylene Diamine Tetra-Acetate (EDTA) for the determination of haematological indices. Haemoglobin concentration (Hb) was estimated using the cyanmethaemoglobin method (Cannan 1958). Packed Cell Volume (PCV), total erythrocyte count and White Blood Cell count (WBC) of blood samples were determined in a Wintrobehaematocrit tube according to the method of Schalm *et al*. (1975). Blood films were made from the pooled EDTA samples following the method of Robertson and Maxwell (1990) and the proportions of basophils, eosinophils, heterophils, lymphocytes and monocytes were determined. Heterophil/lymphocyte (H/L) ratio was then calculated.

Statistical analysis

Data were subjected to analysis of variance using the general linear model procedure of SAS (2010) to determine the main effect of strain, levels of restricted feeding and their interaction (strain x restriction feeding levels). Significant differences were considered at $P < 0.05$ using Duncan Multiple Range Test (Duncan, 1955).

Results

Growth performance

Strain had effect ($P<0.05$) on final weight and daily weight gain as shown in Table 2. Final weight (518.48) and weight gain/day (9.28) in *Bovan nera* pullets were higher ($P<0.05$) than 508.22 and 9.06, respectively in Isa brown.

Restriction of feed had significant impact on the final weight, daily weight gain and feed intake of birds as shown in Table 2. Birds maintained on *ad-libitum* (R_0) feeding recorded highest ($P<0.05$) final weight (544.57g), daily weight gain (9.82g/day) and feed intake (33.70g/bird/day) when compared with those on one-day restricted (R_1) and two-days (R_2) restricted feeding groups which recorded final weight (514.54g and 480.84g), weight gain per day (9.20g and 8.48g) and feed intake (31.11g/bird/day and 28.42g/bird/day), respectively.

Table 2: Main effect of strain and feed restriction on growth performance of growing pullet chicks

	Strain			Restricted feeding			
Parameters	**IsaBrown**	**Bovan Nera**	**SEM**	**R_0**	**R_1**	**R_2**	**SEM**
Initial Weight (g/bird)	64.21	63.84	1.42	63.13	64.66	62.27	1.25
Final weight (g/bird)	508.22^b	518.48^a	2.72	544.57^a	514.54^b	480.84^c	2.69
Weight gain(g/bird/day)	9.06^b	9.28^a	0.07	9.82^a	9.20^b	8.48^c	0.80
Feed intake (g/bird/day)	31.36	30.79	0.38	33.70^a	31.11^b	28.42^c	0.42
Feed conversion ratio	3.46	3.32	0.49	3.44	3.38	3.36	0.06
Protein efficiency ratio	1.53	1.59	0.03	1.53	1.58	1.57	0.03
Mortality (%)	1.11	1.48	0.02	1.67	1.67	0.55	0.02

a, b, c means in the same row not sharing common superscripts are significantly ($p<0.05$) different,
SEM:. Standard error of mean
R_0 – *Ad-libitum* feeding, R_1 - One day feed restriction in a week, R_2 - Two days feed restriction in a week,

Interaction effects between strain and feed restriction on growth performances of pullets are presented in Table 3. All the parameters measured were significantly ($P<0.05$) influenced. The chicks in R_0 group in both strains had the highest final body weight, feed and protein intake while the chicks in group R_2 had the least. The feed conversion ratio (3.11) was best in Bovans Nera on two days feed restriction (R_2) but only differ statistically ($P<0.05$) to R_0 and R_1 of Isa Brown. The final weight (547.74g)

and daily weight gain (9.88g/day) were significantly (P<0.05) higher for the Bovans Nera strain at R_0. Isa brown strain at R_0 recorded 541.40g and 9.77g/day for final weight and daily weight gain, respectively.

Table 3: Interaction between strain and feed restriction on growth performances of pullet chicks

	Isa-Brown			Bovans Nera			
Parameters	**R_0**	**R_1**	**R_2**	**R_0**	**R_1**	**R_2**	**SEM**
Initial Weight (g/bird)	62.90	64.25	65.56	63.44	63.17	64.33	0.94
Final weight (g/bird)	541.40 ^{a}	510.00 ^{b}	473.07 ^{c}	547.74 ^{a}	519.08 ^{b}	488.62 ^{c}	5.15
Weight gain(g/bird/day)	9.77 ^{a}	9.10 ^{b}	8.32 ^{c}	9.88 ^{a}	9.30 ^{b}	8.66 ^{c}	0.12
Feed intake (g/bird/day)	34.31 ^{a}	31.73 ^{b}	27.75 ^{c}	33.08^{ab}	31.04 ^{b}	26.96 ^{c}	0.55
Feed conversion ratio	3.52 ^{a}	3.49 ^{a}	3.34^{ab}	3.35^{ab}	3.34^{ab}	3.11 ^{b}	0.07
Protein efficiency ratio	1.50^{b}	1.51^{b}	1.58^{ab}	1.57 ^{a}	1.58 ^{a}	1.69 ^{a}	0.03
Protein intake(g/bird/day)	6.53 ^{a}	6.04 ^{b}	5.28 ^{c}	6.29 ^{ab}	5.90 ^{b}	5.13 ^{c}	0.11
Mortality (%)	2.22 ^{ab}	0.00 ^{b}	1.11 ^{ab}	1.11^{ab}	3.33 ^{a}	0.00 ^{b}	0.56

a, b, c means in the same row with different superscripts are significantly (p<0.05) different.
SEM: *Standard error of mean*
R_0 – *Ad-libitum* feeding, R_1 - One day feed restriction in a week, R_2 - Two days feed restriction in a week respectively.

Haematological indices

Haematological indices of Isa brown and Bovans Nera pullets raised on different levels of feed restriction is shown in Table 4. Isa brown strain recorded significantly (p<0.05) higher heamogobin, lymphocyte and basophil percentages. Bovans Nera however had significantly (p<0.05) higher heterophil and the ratio of heterophil and lymphocyte. Birds on two days per week feed restriction (R_2) recorded significantly (p<0.05) higher white blood cell compared with R_0 and R_1 birds which had similar values. The interaction of strain and feed restriction showed that Isa brown birds on two days feed restriction (R_2) had the highest (p<0.05) heamoglobin and Packed Cell Volume (PCV) and while the ones on *ad libitum* and one day restricted feeding recorded the highest (p<0.05) lymphocyte and basophil percentages. These group of birds also recorded lowest heterophil and heterophil/lymphocyte ratio.

Table 4: Main effect of strain and feed restriction on haematological indices of growing pullet chicks

	Strain			Restricted feeding			
Parameters	**Isa Brown**	**Bovans Nera**	**SEM**	**R_0**	**R_1**	**R_2**	**SEM**
Packed Cell Volume (%)	24.67	22.83	1.42	22.50	23.50	25.25	0.58
Heamoglobin(gram/dl)	7.60^{a}	6.27^{b}	2.72	6.65	6.78	7.38	0.27
Red Blood Cell	1.78	1.43	0.07	1.70	1.48	1.65	0.11
White Blood Cell	10.01	9.68	0.38	9.575^{b}	8.93^{b}	11.05^{a}	0.35
Heterophil (%)	33.50^{b}	43.00^{a}	0.49	38.75	38.50	37.50	1.97
Lymphocyte (%)	65.00^{a}	56.50^{b}	0.03	59.75	60.50	62.00	1.86
Eosinophil (%)	0.33	0.33	0.02	0.25	0.50	0.25	0.14
Basophil (%)	1.00^{a}	0.00^{b}	0.19	0.75	0.50	0.25	0.19
Monocyte (%)	0.17	0.17	0.11	0.50	0.00	0.00	0.11
Heterophil-lymphocyte ratio	0.52 ^{b}	0.77 ^{a}	0.05	0.67	0.67	0.61	0.05

a, b, c means in the same row not sharing common superscripts are significantly (p<0.05) different
SEM: Standard error of mean
R_0 – *Ad-libitum* feeding, R_1 - One day feed restriction in a week, R_2 - Two days feed restriction in a week,

Table 5: Interactive effect of strain and feed restriction on haematological indices of growing pullet chicks

	Isa-Brown			Bovans Nera			
Parameters	**R_0**	**R_1**	**R_2**	**R_0**	**R_1**	**R_2**	**SEM**
Packed Cell Volume (%)	23.50^{ab}	24.00^{ab}	26.50^{a}	21.50^{b}	23.00^{ab}	24.00^{ab}	0.94
Heamoglobin(gram/dl)	7.30^{ab}	7.10^{ab}	8.40^{a}	6.00^{b}	6.45^{b}	6.35^{b}	5.15
Red Blood Cell	1.85	1.65	1.85	1.55	1.30	1.45	0.12
White Blood Cell	9.60	9.15	11.30	9.55	8.70	10.80	0.55
Heterophil (%)	33.00^{b}	30.00^{b}	37.50^{ab}	44.50^{a}	47.00^{a}	37.50^{ab}	0.07
Lymphocyte (%)	65.0^{a}	68.5^{a}	61.5^{abc}	54.5^{bc}	52.5^{c}	62.5^{ab}	0.03
Eosinophil (%)	0.0	0.5	0.5	0.5	0.5	0.0	0.14
Basophil (%)	1.5^{a}	1.0^{ab}	0.5^{ab}	0.0^{b}	0.0^{b}	0.0^{b}	0.56
Monocyte (%)	0.5	0.0	0.0	0.5	0.0	0.0	0.11
Heterophil-lymphocyte ratio	0.52^{c}	0.44^{c}	0.61^{bc}	0.82^{ab}	0.90^{a}	0.61^{bc}	0.05

a, b, c means in the same row not sharing common superscripts are significantly ($p<0.05$) different
SEM: Standard error of mean
R_0 – *Ad-libitum* feeding, R_1 - One day feed restriction in a week, R_2 - Two days feed restriction in a week

Discussion

The lower body weight and better feed conversion ratio in two days feed restriction groups compared to *ad-libitum* and one day feed restriction in the chicks phase correspond with results reported by other authors in broiler breeder pullets (Bartov, 1988; Bennett and Lesson, 1989; Peak and Brake 2000). Kwakkel *et al.* (1991) recorded lower feed conversion ratio (FCR) for the feed restricted birds than the control group at the grower phase. Mahmood *et al.* (2007), observed significantly poor feed utilization in *ad libitum* fed birds than the feed restricted groups. Lee and Leeson (2001) also observed better feed conversion values in birds kept on restricted feeding compared to *ad libitum* fed birds. The result of this study is in harmony with the reports above. However, Fanooci and Torki (2010) showed no significant difference in the overall FCR between chicks fed the restricted and non-restricted control diet, except for chicks fed on 20% restricted diet that had the highest FCR during the experiment. Bovans Nera strain performed better than the Isa Brown strain in final weight and weight gain. Feed consumption was similar among the two strains but produced higher weight gain in Bovans Nera strain which could be attributed to differences in the body weights of the strains. Sarica *et al.* (2009), recorded significant differences in feed consumptions and weight gain among pullet genotypes.

The main restricted feeding had significant effect on white blood cell. The major functions of the white blood cells (leucocytes) and its differentials are to fight infections, defend the body against invasion by foreign organism and to produce or at least transport and distribute antibodies in immune response. Thus, animals with low white blood cells are exposed to high risk of disease infection while those with high count are capable of generating antibodies in the process of phagocytocis and have high degree of resistance to diseases (Soetan *et al.*, 2013) and enhanced adaptability to local environmental and disease prevalent conditions. The higher white blood cells observed in R_2 birds may have been a response to the stress effect of a more severe restricted feeding applied to this group of birds.

The packed cell volume (PCV) was significantly higher ($P<0.05$) in Isa brown birds on two days feed restriction (R_2).

Packed Cell Volume (PCV) which is also known as haematocrit or erythrocyte volume fraction is the percentage (%) of red blood cells in blood. The high PCV reading indicated either an increase in number of red blood cells (RBCs) or reduction in circulating plasma volume. A low level is an indication of anemia (Aster, 2004). Haemoglobin has the physiological function of transporting oxygen to tissues of the animal for oxidation of ingested food so as to release energy for other body functions as well as transport carbon dioxide out of the body of animals (Ugwuene, 2011; Soetan *et al.*, 2013). The Bovans Nera strain with heavier body weight seem to be more affected by the stress of restricted feeding as it recorded higher heterophil and heterophyl/lymphocytes ratio. The main feed restriction interaction showed triacylglycerol level being highest in birds restricted from feed one day per week and lowest in *ad libitum* fed birds. The strain and sub-restriction interaction reveals cholesterol level in plasma as highest in *ad libitum* fed Bovans Nera with the lowest level in two days restricted Isa brown strain.

Conclusion

Restricted feeding reduced growth performance in both strains compared to *ad-libitum* feeding.Two days per week feed restriction reduced body weight more. The highest value of heterophyl/lymphocytes ratio is observed in Bovans near birds with restricted feeding suggesting more stress in egg-type chicken of heavier strains.

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Received: 13th October, 2017
Accepted: 2nd March, 2018