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Comparative evaluation of the physiological responses and blood profile of the Fulani eco-type chicken, Arbor acre broilers and its crosses during the dry season

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***Target Audience:** Poultry breeds, Blood, physiology, poultry scientists*

Abstract

This study was conducted to compare the physiological response and blood profile of 20 each of 4month old Fulani Eco-type Chicken (FF), Arbor Acre broiler (BB), its crosses (BF) and reciprocal crosses (FB). The study lasted for 8weeks with each bird group having 10 Matured cock and 10 Hen respectively. The live weight of the birds were determined using a digital weighing scale while physiological parameters Rectal Temperature (RT), Respiratory Rate (RR) and Heart Rate (HR) were measured during the hot afternoon between 1-3pm. The ambient temperature and humidity were measured using a digital thermo-hygrometer. Blood samples were collected for the determination of haematological indices and serum analysis. The result indicated that strain influenced the physiological parameters ($p<0.05$), FF had the lowest RT (41.3^0C) while the highest was recorded in BB (42.3^0Cunit), RR and HR followed the same trend with BB having the least mean while FF, BF and FB were similar. RR recorded for FF, BF, FB and BB were 30.6, 31.8, 32.4 and 42.0 breaths/minute while HR was 198.6, 193.8, 201 and 219beats/minute respectively. All parameters evaluated were influenced by sex ($P<0.05$). RT was higher in males (41.9^0C) compared to females (41.5^0C). The RR (37.5 breaths/minute) and HR (210.00 beats/minute) of hens were higher than those of cocks which were 30.9 breaths/minute and 196 beats/minute respectively. The strains influenced ($p<0.05$) Red blood cells, White blood cells and blood platelets while packed cell volume and Heamoglobin were not affected. The red blood cells and white blood cells followed similar trend with FF having higher count while BF and FF had similar counts whereas BB had the lowest count. Parameters such as Albumin, Aspartate aminotransferase, Alanine aminotransferase and Alkaline phosphatase were not influenced whereas total protein, Glucose, Globulin and creatinine were influenced ($P<0.05$) by strain. It is concluded from this study that the Fulani Eco-type chicken (FF) followed by the crosses (BF and FB) had better physiological response compared to the Broiler Chicken.

***Key words**: Physiological response, blood profile, Fulani ecotype, broiler chickens, crosses*

Description of Problem

The role of the Poultry industry in producing animal protein effectively within the shortest possible time cannot be overemphasized due to the rapid growth and prolificacy (1). Some of the problems limiting poultry production in Nigeria are diseases, high cost of feed, heat stress and poor reproductive rate (low fertility and hatchability) and this is majorly due to the usage of exotic chicken that evolved to suit the climatic regions of the temperate. The broiler chicken is a rapid growing meat-type chicken with high feed conversion ratio but associated with high level of heat stress, high susceptibility to diseases and remains very fragile compared to the Nigerian Indigenous chicken (2). Some physiological parameters that can be used to determine positive or negative physiological response of animals (chicken) includes haematology and serum biochemistry, heart rate, respiratory rate, rectal

temperature amongst others (2). Rectal temperature (RT), Heart rate (HR) and Panting Rate (PR) are part of physiological responses that reflect thermoregulation and the health status of animals, these parameters has been suggested as indicators of the level of heat stress in chickens (3). The potentials of the Nigerian Indigenous chicken (NIC) most especially the Fulani Eco-type chicken which was noted by (4) as an heavy ecotype chicken found in the dry Savannahs (Guinea and Sahel Savannah), Montane regions and cattle Kraals of the North which are known to be hotter than most regions in Nigeria and weigh about 0.9-2.5 kg at maturity have not been fully harnessed.

Local chickens are important in overall food production systems in developing economies mostly because of their adaptation to the tropical environment. They may appear to produce less than highly specialized commercial breeds; however, they possess attributes that make their sustainability on available local resources more ecological and economical in the long term (5, 6). Incorporation of the Nigerian local chicken as a parent breed stock in the nation's breeding programme is important to meet the increase in poultry product demand by the citizenry. This motivated the Institute of Agricultural Research and Training, Moor Plantation, Ibadan to embark on a breeding programme using selected Fulani Eco-type Chicken with commercial prospects and Arbor Acre Broiler Breeders to harness the positive qualities of both breeds. Hence, this study was conducted to evaluate the comparative physiological response of the Fulani eco-type chicken, arbor acre broilers, its straight and reciprocal crosses during the dry season.

Materials and Methods

This study was conducted at the Nigerian Indigenous Chicken (NIC) poultry improvement Unit, Bora farm of the Institute of Agricultural Research and Training, Ibadan. Data from the study was collected thrice weekly over a period of 8weeks from 4months old 20 pure Abor Acre broiler chicken, 20 pure Fulani chicken, 20 Fulani and Abor acre crosses and 20 of their reciprocal crosses. The birds were made up of 10 male (Matured cock) and 10 female (Hen) of each strain which were housed individually in battery cages.

The live weight of the birds were measured at the commencement of the study using a digital sensitive weighing scale while physiological parameters Rectal Temperature (RT), Panting Rate (PR) and Heart Rate (HR) were measured during the hot afternoon. RT was measured using a digital thermometer with an accuracy of $\pm 0.1^{o}C$ and range of measurement of $32\text{-}42.9^{o}C$ which was inserted into the cloaca of the birds, Panting rate of the birds were measured by observing and counting the breadths taken/minute while the heart rate was determined using a stethoscope with model no OGO 1 which was placed on the flank to listen and count the no of heart beats/minute. The ambient temperature and humidity was measured using a digital thermohygrometer which was placed in the pen during record collection.

Blood samples were collected into vials containing ethylene diamine tetra-acetate for the determination of haematological indices and the remaining into universal bottles without anticoagulant for serum analysis. Haemoglobin concentration (Hb) was estimated using the cyanmethaemoglobin method. Packed cell volume (PCV), red blood cell (RBC), and white blood cell count (WBC) were determined with Wintrobe haematocrit tube according to the method of (7). Sera were harvested from blood by centrifugation and kept inside the freezer until needed for biochemical analysis. Total serum protein and albumin were determined using bromocresol purple method (8). Serum uric acid concentration was estimated according to

standard procedures of (9). Serum creatinine level was determined using the method described by (10). Alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase were determined by standard methods using Randox test kits (Randox_ Laboratories, Antrim, UK).

Statistical analysis:

Data generated were subjected to analysis of variance using the general linear model procedure of the SAS (2000). A probability of (P<0.05) was considered to be statistically significant using Duncan Multiple Range Test of the same package.

Results and Discussion

Table 1: Meteorological parameters observed during the experimental period

Time measurement (H)	Average Ambient Temperature (^{0}C)	Relative Humidity (%)	Temperature-Humidity index
1-3pm	31.5	85.5	120.5

Table 2: Effect of Strain on the Physiological response of Fulani Eco-type chicken, Arbor Acre broilers and its crosses

STRAIN	LWT	RT	RR	HR
FF	1.67^{c}	41.30^{c}	30.60^{b}	198.60^{b}
BF	3.48^{a}	41.50^{bc}	31.80^{b}	193.80^{b}
FB	2.35^{b}	41.80^{b}	32.40^{b}	201.00^{b}
BB	3.58^{a}	42.30^{a}	42.00^{a}	219.00^{a}
±SEM	0.519	0.403	8.330	17.700
***P* Value**	0.001	0.001	0.05	0.05

^{a,b,c}Means with different superscripts along the same column are different

Foot note: FF: Fulani Ecotype chicken, BF: Direct cross of Broiler and Fulani Ecotype chicken, FB: Reciprocal cross of Broiler and Fulani Ecotype, BB: Broiler breeder, LWT: Live Weight, RT: Rectal temperature, RR: Respiratory rate, HR: Heart rate

Table 2 shows the effect of strain on the physiological response of Fulani Eco-type chicken, Arbor Acre broilers and its crosses, there was significant difference (p<0.05) in all the parameters considered. The live weight was highest in BB and BF, followed by FB while FF was lowest, this results obtained for FF corroborates the report of (4). BB and BF having the same weight suggests that the report of (6) to harness the potential of indigenous breeds could yield positive results. RT was lowest in FF and highest in BB while BF and FB were lower than BB. Similar to RT, the Respiratory rate (RR) and Heart rate (HR) followed the same trend with BB having the highest values compared to the other strains which were statistically similar. This result suggests that BB was more prone to heat stress compared to the other strains which corroborates the report of (2), according to (11) the effect of thermal stress is more pronounced in specialized strains with high growth potential compared to slower-growing chickens. The crosses and reciprocal crosses having values of RT, RR and HR similar to FF suggests that traits effective in combating heat stress has been passed on to the crosses from their parents while the live-weight been significantly higher than those of the Fulani Eco-type chicken (FF) also suggests that the rapid growth rate and body weight of the BB was evident in the crosses. However, the values obtained for RR stood within normal range (40-60breaths/minute) as reported (11).

Table 3: Effect of sex on the physiological response of Fulani Eco-type chicken, Arbor Acre broilers and its crosses

Sex	LWT	RT	RR	HR
Hen	2.45[b]	41.50[b]	37.50[a]	210[a]
Cock	3.10[a]	41.90[a]	30.90[b]	196[b]
±SEM	0.200	0.115	1.950	4.080
P-Value	0.001	0.05	0.01	0.01

Means with different superscript [a, b, c] along the same column are different
Foot note: LWT: Live Weight, RT: Rectal temperature, RR: Respiratory rate, HR: Heart rate

Table 3 shows the effect of sex on the physiological response of Fulani Ecotype chicken, Arbor Acre and its crosses. All parameters evaluated were significantly influenced by sex ($P<0.05$). The Live-weight of cocks were significantly higher than those of hen, this coincides with the report of (12). RT was also significantly higher ($p<0.05$) in males compared to females and this completely differs from (12) who reported no effect of sex on RT. The RR was higher in hen, this differs from the report of (12) where respiratory rate was not influenced by strain and sex. The HR of hen was higher than those of cock and this differs from the report of (12) where male heart rate was higher than those of females.

Table 4: Interactive effect of sex and strain on the physiological response of Fulani Eco-type chicken, Arbor Acre broilers and its crosses

Strain	Sex	LWT	RT	RR	HR
FF	Hen	1.22[d]	41.08[d]	34.80[c]	202.80[ab]
BF	Hen	3.30[ab]	41.38[cd]	37.20[b]	198.00[ab]
FB	Hen	1.76[cd]	41.52[bcd]	36.00[b]	216.00[ab]
BB	Hen	3.50[ab]	42.18[ab]	42.00[a]	223.20[a]
FF	Cock	2.12[c]	41.50[bcd]	26.40[d]	194.40[ab]
BF	Cock	3.66[a]	41.66[bcd]	26.40[d]	189.60[b]
FB	Cock	2.94[b]	42.06[abc]	28.80[cd]	186.00[b]
BB	Cock	3.66[a]	42.46[a]	42.00[a]	214.80[ab]
±SEM		0.160	0.125	2.498	5.110
P-Value		0.05	0.05	0.05	0.05

Means with different superscripts [a, b, c] along the same column are p<0.05 different
Foot note: LWT: Live Weight, RT: Rectal temperature, RR: Respiratory rate, HR: Heart rate

Table 4 indicated the interactive effect between strain and sex for all parameters were significantly influenced. The LWT was highest in BB and BF cocks while the FF hens were the lowest. The RT was lowest in FF hen and highest in BB cock. The crosses and reciprocal crosses had values lower than those of BB. The RR of BB cock and hen (42.00breaths/minute) were the highest while those of FF and BF cocks were the lowest. The HR of BB hen was the highest while those of the BF and FB cocks were the lowest although similar to the values of others.

Table 5: Mean values of the haematological profile of Fulani Eco-type chicken, Arbor Acre broilers and its crosses

Parameters	FF	BF	FB	BB	±SEM	*P*-Value
Packed Cell Volume (%)	27.34	26.74	26.63	25.98	0.517	NS
Haemoglobin (g/dL)	8.75	8.43	8.39	8.13	0.240	NS
Red Blood Cells (x10^6/µL)	2.87^a	2.42^b	2.58^b	2.35^c	0.112	0.05
White Blood Cells (x10^3/µL)	16.78^a	14.31^b	14.33^b	13.40^c	0.239	0.01
Platelets (x10^6/µL)	1.77^a	1.53^c	1.64^b	1.51^c	2.637	0.01

Means with different superscript $^{a, b, c}$ along the same row are different

Foot note: FF: Fulani Ecotype chicken, BF: Direct cross of Broiler and Fulani Ecotype chicken, FB: Reciprocal cross of Broiler and Fulani Ecotype, BB: Broiler breeder

Table 5 shows the mean values of the haematological profile of Fulani Eco-type chicken, Arbor Acre broilers and its crosses. The results were significantly influenced (p<0.05) for Red blood cells, White blood cells and blood platelets while the packed cell volume and the Heamoglobin were not influenced by the strain. The red blood cells and white blood cells followed the same trend with the FF having the highest count, the BF and FF having similar counts while the BB had the lowest count suggesting that the immunity of the BB were compromised corroborating the finding of (2).

Table 6: Mean values of serum biochemistry of Fulani Eco-type chicken, Arbor Acre broilers and its crosses

Parameters	FF	BF	FB	BB	±SEM	P-Value
Total Protein (g/dL)	6.58^a	6.25^b	6.20^b	6.05^c	0.0826	0.05
Glucose (mg/dl)	192^a	187^b	190^a	172^c	1.99	0.05
Globulin (g/dL)	4.56^b	4.66^b	4.88^{ab}	4.99^a	0.0593	0.05
Creatinine (g/dL)	0.91^a	0.75^b	0.79^b	0.62^c	0.0125	0.05
Albumin (g/dL)	1.84	1.44	1.47	1.41	0.0662	NS
Aspartate aminotransferase (U/dL)	196	194	193	192	2.07	NS
Alanine aminotransferase (U/dL)	32.30	27.60	28.90	26.60	1.23	NS
Alkaline phosphatase (U/dL)	28.90	26.80	28.80	25.80	9.93	NS

Means with different superscript $^{a, b, c}$ along the same row are different

Foot note: FF: Fulani Ecotype chicken, BF: Direct cross of Broiler and Fulani Ecotype chicken, FB: Reciprocal cross of Broiler and Fulani Ecotype, BB: Broiler breeder

The mean values of serum biochemistry of Fulani Ecotype chicken, Arbor Acre broiler and its crosses are presented in Table 6. The results of parameters such as Albumin, Aspartate aminotransferase, Alanine aminotransferase and Alkaline phosphatase were not influenced by strain (P>0.05) while total protein, Glucose, Globulin and creatinine were influenced (P<0.05). The total protein and creatinine followed the same trend, the highest values were recorded in FF followed by BF and FB while BB had the lowest. The Glucose was highest in FF (192 mg/dl) and FB (190 mg/dl) followed by BF (187 mg/dl) while BB (172 mg/dl) had the lowest. The creatinine values were highest in FF (0.91 g/dL) and

lowest in BB (0.62 g/dL) while BF (0.75 g/dL) and FB (0.79 g/dL) had same value statistically. The serological results obtained for FF and its crosses with BB are in consonance with the reports of (13) and (14) suggesting that the elevated levels of total protein, glucose and creatinine indicates a better cell mediated immune response compared to the BB.

Conclusion and Applications

1. It is evident from this study that the Fulani Eco-type chicken (FF) followed by the crosses (BF and FB) had better physiological response compared to the Arbor Acre chicken (BB).
2. It is recommended that the genetic improvement and physiological evaluation continue until crosses can attain weight gain and FCR similar to the broiler chicken.
3. This study throws more light on the benefits of upgrading the Nigerian indigenous chicken for better productivity.
4. The results obtained suggest that farmers can have a chicken that suits perfectly into the tropical climate without the constraints associated with physiological responses of the broiler exotic chicken.

References

1. Hosseinzadeh, M.H., Ebrahimnezhad, Y., Janmohammadi, H., Ahmadzadeh, A. R and Sarikhan, M. (2010). Poultry byproduct meal: Influence on performance and egg quality traits of layers. *International Journal of Agricultural Biology*, 12(4):547-550.
2. Salako, A. E. and Ige, A. O. (2006). Haemoglobin polymorphism in the Nigerian indigenous chickens. *Journal of Animal Veterinary Advance*, 5: 897 – 900.
3. Deeb, N. and A Cahaner (1999). True effects of Naked Neck genotypes, arnbient temperature, and feeding status and their interactions on body temperature and performance of broilers. *Poultry Science*. 78, 1341-1346.
4. Olori. V. E. (1992). An evaluation of two ecotypes of the Nigerian Indigenous chicken M.Sc. Thesis Obafemi Awolowo University Ile Ife.
5. Oleforuh-Okoleh, V. U. (2013). Genetic gains from within-breed selection for egg production traits in a Nigerian local chicken *ARPN Journal of Agricultural and Biological Science*, 8: 788-792
6. Mkpughe, J. I. and Bratte, L. (2015). Effects of breed and frequency of ejaculation on semen characteristics of chickens. *International Journal of Livestock Research,* 5: 42-50.
7. Schalm, O. W. Jain, N. C. and Carol, E. I. (1975) Veterinary Haematology 3rd Edition Lea and Febiger, Philadephia, P:144-167
8. Varley, H. Gowenlock, A. H. and Bell, M. (1980). Practical Biochemistry. 5th Edn., William Heinemann Medical Books Ltd., London.
9. Wootton, T. D. (1964). Micro analysis in Medical Biochemistry, 4th edition. Churchill, London, pp: 409.
10. Tietz, N.W. (1986). Textbook of clinical chemistry. Philadelphia, WB Saunders Co.
11. Nascimento, S. T. da Silva, I. O. J. Mourao, G. B. and Castro, A. C. (2012). Bands of respiratory rate and cloacal temperature for different broiler chicken strains. *Revista Brasileira de Zootecnia*, 41: 1318-1324.
12. Mutibvu, T. Chimonyo, M. and Halimani, T. E. (2017). Physiological

Responses of Slow-Growing Chickens under Diurnally Cycling Temperature in a Hot Environment. *Revista Brasileira de Ciência Avícola*, 19(4):567-576.

13. El-Safty, S.A. Ali, U. M. and Fathi, M. M. (2006). Immunological parameters and laying performance of naked neck and normally feathered genotypes of chicken under winter conditions of Egypt. *International Journal of Poultry Science*, 5: 780-785.
14. Ladokun, A. O. Yakubu, A. Otite, J. R. Omeje, J. N. Sokunbi O. A. and Onyeji, E. (2008). Haematological and serum biochemical indices of Naked Neck and Normally Feathered Nigerian Indigenous Chickens in a sub humid tropical environment. *International Journal of Poultry Science* 7 (1): 55-58.