ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 2 (2): 117-119, 2003
© Asian Network for Scientific Information 2003

Physiological Responses of Broiler Chickens to Quantitative Water Restrictions: Haematology and Serum Biochemistry

F. C. Iheukwumere[1] and U. Herbert[2]
[1]Department of Agriculture, Abia State University, P. M. B. 1526, Umuahia, Nigeria
[2]Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria

Abstract: The effect of water restriction on haematology and serum biochemistry of broiler chickens was investigated. A total of ninety six 4-week old Anak broiler birds were used for this study. The birds were divided into 4 treatment groups and within each group, replicated three times at 8 birds per replicate. Different quantities of water were fed to the birds as treatments, that is, *ad libitum* (T_0), 3.2 liters (T_1), 2.2 liters (T_2), 1.2 liters (T_3) per day in a completely randomized design (CRD) experiment. The results show that the haematological values were significantly influenced ($P<0.05$) by severity of water restrictions. However, broilers on T_3 (1.2 liters of water restriction) showed a higher mean value for white blood cell (WBC), which differed, significantly from T_0 (control) and T_1 (3.2 liters of water restrictions). The mean values of the chemical constituents (Na^+, K^+, Ca^{++}, Cl^-, HCO_3^-) in the sera of the broiler chickens were significantly ($P<0.05$) influenced by severity of water restrictions. There was no significant difference ($P>0.05$) for Alkaline phosphatase and Aspartate transaminase enzyme activity but Alanine transaminase showed significant differences ($P<0.05$) between the treatments. Total protein albumin showed significant ($P<0.05$) difference between the treatments but serum globulin did not differ significantly ($P>0.05$) between the treatments.

Key words: Water restriction, haematology, serum biochemistry, broiler chickens, tropics

Introduction

Water intake by animals is intermittent, even more so than food, but the loss of water from the body is continuous although variable. Thus, the body must be able to compensate in order to maintain its physiological functions. The most noticeable effect of moderate restriction is reduced feed intake and reduced productivity (Esonu, 2000). Obioha (1992) reported that with more severe restriction, weight loss is rapid as the body dehydrates. The dehydration is accompanied by increased excretion of nitrogen and electrolytes such as sodium (Na^+) and potassium (K^+) and increase in urea, total protein, chloride in the serum.

A decline in the red blood count due to severity of water restriction in animals has been reported by Hill and Powell (1975), an increase in digestive juice per unit of feed especially that of the pancreatic lipase activity in the duodenum. The process of haemodilution and haemoconcentration are apparently dependent on types and duration of water restriction (Graf, 1984). Water restriction is known to reduce feed consumption (Hill and Powell, 1975). Inevitably, this has been associated with poorer growth and reduction in body weight of broiler chickens (Kekeocha, 1984). Roubicek (1969) reported that water restriction causes more severe or quicker responses when temperatures are stressing. These authors have not specified the optimum level of restriction that can cause low response in the parameters mentioned above. It is against this background that this study was conducted to determine the effect of water restriction on haematology and serum biochemistry of broiler chickens raised in a humid tropical environment.

Materials and Methods

A total of one hundred (100) Anak 2000 day old broiler chicks were fed commercial starter feed for the first 4 weeks of life. At the end of brooding stage (4th week), ninety six birds were randomly selected and allocated to four groups correspondingly to the number of treatment and each treatment group was replicated three times giving a total of twelve replicates with 8 birds per replicate and were immediately weighed. The birds were fed on commercial feed. Water was given at different levels *ad libtum* (T_0), 3.2 liters (T_1), 2.2 liters (T_2), and 1.2 liters (T_3) per day in a completely randomized (CRD) experiment. Apart from water and feeding the birds, other management practices such as routine vaccination, drug administration and maintenance of cleanliness in and outside the poultry house were observed. Mean daily live weight, mean daily feed intake were recorded.

Collection of blood samples: Blood samples were collected from the jugular vein of 3 birds per replicate into a set of sterilized glass tubes containing ethylene diamine tetra acetic acid (EDTA) for determination of haematological parameters and a second set of glass tubes without anticoagulant for serum separation. Serum samples were stored in a deep freezer for further analysis.

Analytical Procedures: The PCV (packed cell volume) was determined using a haematocrit. RBC (Red blood cells) was determined using an improved Neubeur haemocytometer after the appropriate dilution. Blood indices and corpuscular contents, MCV (mean corpuscular haemoglobin concentration) were

Table 1: Effect of water restriction on haematological indices of broilers

Parameters	Treatments				
	T_0 *(ad lib)*	T_1 (3.2 liters)	T_2 (2.2 liters)	T_3 (1.2 liters)	SEM
PCV (%)	38.00[a]	29.00[a]	17.00[ab]	6.00[b]	6.98
RBC (x $10^6/\mu$1)	9.20[a]	8.50[ab]	7.50[bc]	7.20[b]	0.44
WBC (x$10^3/\mu$l)	6.80[b]	7.00[b]	8.20[ab]	9.00[a]	0.52
Hb (g/100ml)	13.00[a]	10.00[a]	6.00[ab]	2.00[b]	2.39
MCV(f7)	41.00[a]	36.50[a]	22. 70[ab]	8.30[b]	7.36
MCH (pg)	14.00[a]	12.50[a]	8.00[ab]	2.80[b]	2.52
MCHC (pg)	35.00[a]	34.50[a]	34.00[ab]	33.00[b]	0.48

[ab] means within the same row followed by different superscripts are significantly different (p<0.05).

Table 2: Effect of water restriction on serum biochemistry of broiler chickens

Parameters	Treatments				
	T_0 *(ad lib)*	T_1 (3.2 liters)	T_2 (2.21 liters)	T_3 (1.2 liters)	SEM
Sodium (mmol/l)	57.00[a]	58.00[a]	66.00[b]	68.00[b]	2.78
Potassium (mmol/l)	1.20[b]	1.50[ab]	1.80[a]	1.85[a]	0.15
Chloride (mmol/l)	34.00[b]	38.00[a]	38.00[a]	38.00[a]	1.00
Bicarbonate (mmol/l)	15.10[b]	16.30[a]	16.32[a]	16.50[a]	0.38
Calcium (mg/dl)	15.00[b]	15.30[a]	15.40[a]	15.35[a]	0.09
Urea (mg/dl)	3.25[a]	3.20[a]	3.20[a]	3.00[b]	0.05
Creatinine (fig/dl)	20.00[b]	20.00[b]	21.06[a]	21.00[a]	0.28

Table 3: Effect of water restriction on enzyme activities in sera of broiler chickens

Parameters	Treatments				
	T_0	T_1	T_2	T_3	SEM
Alkaline phosphate (μl)	2.15	2.20	2.20	2.20	0.03
Alanine transaminase (μl)	22.I0[b]	22.20[a]	22.20[a]	22.20[a]	0.03
Aspartate transaminase (μ1)	31.00	31.00	31.00	31.00	0.30

Table 4: Effect of water restriction on serum protein of broiler chicken

Parameters	Treatments				
	To *(ad lib)*	T_1 (3.2 liters)	T_2 (2.2 liters)	T_3 (1.2 liters)	SEM
Total protein (g/dl)	88.00[a]	86.00[b]	86.00[b]	86.40[b]	0.48
Albumin (g/dl)	24.00[ab]	23.60[b]	24.30[a]	24.40[a]	0.18
Globulin (g/dl)	64.00	62.40	61.70	62.00	1.86

determined using the appropriate formulae. Total protein was determined by Kjedahl method as described by Kohn and Allen (1995), while Albumin was determined using the BCG (bromocresol green) method as described by Peters *et al.* (1982). Aspartate transaminase (AST), Alanine transaminase (ALT) and Alkaline phosphatase (ALP) activities were determined using spectrophotometric method as described by Rej and Hoder (1983); Hoder and Rej (1983); McComb *et al.* (1983) respectively. Sodium and potassium were determined by flame photometry (Mouldin *et al.*, 1996).

Statistical Analysis: The data from this study were subjected to statistical analysis using the analysis of variance (Steel and Torrie, 1980) while the treatment means were compared using Duncan's New Multiple Range Test as outlined by Obi (1990).

Results and Discussion

The effect of water restriction on haematological indices of the broiler chicken is shown in Table 1. There was significant difference (P<0.05) in all the parameters investigated with severity of water restrictions. However, broilers on T_3 (1.2 liters of water restrictions) showed a higher WBC value of 9.00 x $10^3/\mu$1, which differed significantly (P<0.05) from T_0 *(ad lib* water) and T_1 (3.2 liters water restriction) but did not differ significantly (P>0.05) from T_2 (2.2 liters of water restriction). A decline in the red blood counts due to severity of water restriction in birds has been reported by Hill and Powell (1975). The process of haemodilution and haemoconcentration are apparently dependent on type and duration of water restriction (Graf, 1984). The broilers on *ad libitum* water supply showed superior values in almost all the parameters investigated.

Table 2 shows the effect of water restriction on serum biochemistry of broiler chickens. The mean values of the chemical constituents (Na, K, Cl, HCO_3 and Ca) in the sera of the broiler chickens were significantly (P<0.05) influenced by severity of water restrictions. Higher mean values were obtained from birds on T_3 (l.2 liters) of water restriction. This is in agreement with the findings of Obioha (1992) who reported that with more severe restriction weight loss is rapid as the body dehydrates. The dehydration is accompanied by increased excretion

of nitrogen and electrolytes such as potassium and sodium. The low serum urea observed in broilers on T_3 (1.2 liters) of water restriction may be attributed to good quality protein utilization which is shown by high total protein recorded in the group of broilers. This agrees with the findings of Awosanya *et al.* (1997) and Esonu *et al.* (2001).

The results of enzyme activities in the sera of the experimental broilers are shown on Table 3. There was no significant difference ($P>0.05$) between the treatments for alkaline phosphatase and aspartate transaminase enzyme activities. However, alanine transaminase activity showed significant difference ($P<0.05$) between the treatments. This is in agreement with the findings of Fasina *et al.* (1999) in broiler chickens that had reported an increase in enzyme activity due to severity of water restriction in animals. Broilers on T_3 (1.2 liters) treatment showed difference in enzyme activity from those of the control treatment in alanine transaminase. This is an indication that cellular necrosis could have occurred in the broilers as was suggested by Fasina *et al.* (1999) and Sokunbi and Egbunike (2000).

Table 4 shows the total serum protein of broilers on restricted water intake of broiler chickens. There was significant difference ($P<0.05$) between treatment and control means on total serum protein levels in the broiler chickens. It has been observed that serum urea, total protein and creatinine contents depend on both the quantity and quality of protein supplied in the diet (Iyayi and Tewe, 1998). A major source of excess creatinine in blood of animals is from the muscle when wasting occurs and creatinine phosphate is catabolized (Bell *et al.*, 1972).

Conclusion: The results obtained in this study show that severity of quantitative water restrictions in broilers up to 1.2 liters per day has deleterious effect on the haematology but had no deleterious effect on the serum biochemistry.

References

Awosanya, B., J. K. Joseph and S. O. Sowumi, 1999. Performance of rabbits on graded dietary levels of roasted *Leucaena leucocephala* seed meal. J. Appl. Anim. Res., 9: 235-239.

Bell, G. H., D. Esmilie-Smith and C. R. Patterson, 1972. Textbook of physiology and biochemistry. Churchill, Living stone Edinburgh, pp: 229-230.

Esonu, B. O., 2000. Animal nutrition and feeding. A functional approach. Ist edn. R and R Books. Owerri, Nigeria, pp: 131-179.

Esonu, B. O., O. O. Emenalom, A. B. I. Udedibie, U. Herbert, C. F. Ekpor, I. C. Okoli and F. C. Iheukwumere, 2001. Performance and blood chemistry of weaner pigs fed raw Mucuna bean (Velvet bean) meal. Trop. Anim. Prod. Invest., 4: 49 - 54.

Fasina, O. F., A. D. Ologhobo, G. O. Ayoada, G. A. Adeniran and O. Adeyemi, 1999. Nutritional and toxicological assessments of *Vernonia amygdalina* leaves in nutrition of broiler chicks. 2: Effect on performance haematology and biochemistry indices. Proc. 4th Ann. Conf. Anim. Sci. Assoc. Nig. (ASAN) 14th -16th Sept., IITA, Ibadan, Nigeria, 19-22.

Graf, F., 1984. Of what value are blood tests? Physiological characteristics to estimate the capacity and reliability of cattle. Anim. Res. Dev., 19: 125 - 188.

Hill, A. T. and A. J. Powell, 1975. Patterns of water intake in caged birds. Br. Vet. J., 15: 133-139.

Hoder, M. and R. Rej, 1983. Alanine transaminase. In: Methods of enzymatic analysis. 3rd ed. H. U. Bergmeyer, I. Bergmeyer and M. Grassl (eds). Weinhen Velag-Chemie.

Iyayi, E. A. and O. O. Tewe, 1998. Serum total protein, urea and creatinine levels as indices of quality of cassava diets for pigs. Trop. Vet., 16: 57- 67.

Kekeocha, C. C., 1984. Nutrition, poultry production handbook, 2nd edition. Pfizer Coy. Nairobi.

Kohn, R. A. and M. S. Allen, 1995. Enrichment of proteolytic activity relative to nitrogen in preparations from the rumen for *in vitro* studies. Anim. Feed Sci. Tech., 52: 1- 4.

Loosing, W., 1980. Inaugural dissertation. Proc. Soc. Exper. Bio. Med., 143: 545- 547.

Mouldin, R. E., O. A. Goldale, R. M. Engeman, M. J. Goodall, R. K. Craves and J. J. Johnston, 1996. Determination of zinc phosphide residue in the California ground squirrel *(Speraphilus beecheyi)* by gas chromatography flame photometric determination. J. Agri. Food Chem., 11: 189 -191.

McComb, R. B., G. N. Bowers and S. Rosen, 1983. Alkaline phosphate. New York, Plenum Press, New York.

Obi, I. U., 1990. Statistical methods of detecting differences between treatment means. 2nd ed. Snaap Press, Enugu, Nigeria.

Obioha, F. C., 1992. A guide to poultry production in the tropics. Acena Publication, Nigeria, pp: 86 -100.

Peters, T., G. T. Biamonte and B. T. Doumas, 1982. Protein (total protein) in serum. In: Selected methods of clinical chemistry. G. W. R. Faulkner and S. Mcites (eds). Am. Assoc. Clin. Chem.

Rej, R. and M. Hoder, 1983. Aspartate aminotransferase. In: Methods of enzymatic analysis. 3rd ed. H. U. Bergmeyer, J. Bergmeyer and M. Grassl (eds). Weinheim, Velachemie, 3: 416-433.

Roubicek, G. B., 1969. Animal Nutrition and Growth. Lea and Febiger, Philadelphia.

Sokunbi, A. O. and G. N. Egbunike, 2000. Physiological response of growing rabbits to neem *(Azadirachta indica)* leaf meal based diets: Haematology and serum biochemistry. Trop. Anim. Prod. Invest., 3: 81-87.

Steel, R. G. D. and J. H. Torrie, 1980. Principles and procedures of statistics: A biometrical approach, 2nd ed. McGraw-Hill Book Coy. Inc., New York.