Journal of Advances in Biology & Biotechnology
11(2): 1-7, 2017; Article no.JABB.30227
ISSN: 2394-1081

SCIENCEDOMAIN *international*
www.sciencedomain.org

Haematology and Serum Indices of Finisher Broiler Chickens Fed Acidified Blood Meal-based Diets

O. A. Ogunwole[1*], O. A. Abu[1], B. S. Adedeji[1], F. O. Jemiseye[1], A. Y. P. Ojelade[1] and O. O. Tewe[1]

[1]Animal Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors OAO, OOT and OAA designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Authors BSA and FOJ managed the analyses of the study. Authors OAO, BSA and AYPO managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JABB/2017/30227
Editor(s):
(1) Csilla Tothova, Clinic for Ruminants, University of Veterinary Medicine and Pharmacy in Kosice, Slovak Republic.
Reviewers:
(1) Nelson Pérez Guerra, University of Vigo, Spain.
(2) Sohair Youssef Saleh, Cairo University, Egypt.
(3) F. Rumosa Gwaze, Lovedale TVET College, South Africa.
(4) M. Ashraful Kabir, Cantonment College, Bangladesh.
Complete Peer review History: http://www.sciencedomain.org/review-history/17518

Original Research Article

Received 26th October 2016
Accepted 27th December 2016
Published 13th January 2017

ABSTRACT

The effects of Biotronics SE[R] (an acidifier) in a blood meal-based diet on haematology and serum indices of broiler finishers were assessed in this study. One hundred and eighty, one-day old broiler chicks were randomly allotted to four treatments in triplicates of 15 birds per replicate. Birds were initially raised on broiler starter diet devoid of blood meal and subsequently placed on experimental blood meal based finisher ration for another four weeks. T1 (control diet) with no blood meal or acidifier, T2 (Co-supplementation of 0.3% biotronics and 2% blood meal), T3 had 2% blood meal supplementation while T4 had 0.3% acidifier. Birds were offered feed and water *ad-libitum*. Dietary acidifier in blood meal based diets had no significant effect (P> 0.05) on all determined haematological indices of broiler chickens. Serum aspartate amino transferase (AST) levels 49.46, 42.53, 41.76 IU/dL was similar (P>0.05) for T1, T2 and T4, respectively but differed significantly from T3 with AST value of 29.77 IU/dL. However, dietary acidified supplemented group revealed variable results in serum protein indices (total protein, globulin and albumin). Co-supplementation of acidifier and blood meal elevated serum cholesterol but lowered serum uric acid. Dietary acidifier at

**Corresponding author: E-mail: droaogunwole@gmail.com, oluogunwole@yahoo.com;*

0.3% for finisher broiler chicken in blood meal-based diets had no adverse influence on the haematological profile of broilers. Conversely, it altered most serum indices which may have implied on the metabolism of nutrients in the fed chickens.

Keywords: Acidifier; blood; haematological profile; co-supplementation.

1. INTRODUCTION

The persistent inadequate supply of animal proteins in the developing countries necessitated the basis for expansion of livestock industry production activities to catch up with the protein needs of Nigerians. To achieve this laudable vision, the poultry industry has a cardinal role to play with emphasis on broiler chicken as the choice animal to bridge this gap due to its genetic makeup and optimum response to good nutrition and management [1].

Intensive broiler chicken production requires among other factors, adequate and balanced feeds which accounts for about 60-80% of the total cost of raising poultry birds [2]. Feed ingredients are however, very costly due to the ever growing human population [3] and severe competition by humans for available feed ingredients [4]. A possible way to reduce cost of production and improve supply of poultry products is through the use of cheaper, locally available sources of protein such as blood meal in place of costly fishmeal and imported soybean [5]. Blood meal is a major by-product which has no conventional use in the animal farming practices as it is usually found dumped in unsupervised sites in cities and villages [6]. Recent study [7] indicated blood meal can easily be incorporated into broiler rations. Blood meal has been reported to be rich in lysine, arginine, methionone, cysteine and leucine though, deficient in isoleucine [8] and adjudged as the richest sources of arginine, cysteine, leucine [9] but poor in isoleucine and contains less glycine than fish or bone meal.

Despite its importance as an excellent source of some amino acids, it has a major disadvantage which is its heavy load of harmful microbes especially *Salmonella spp, E. coli and clostridium* which therefore limit its use in poultry production [10]. The most recent devise of maintaining gut flora without negative consequences on humans is through the introduction of natural alternatives like prebiotics, enzymes, essential oils, immunomodulators and acidifiers to antibiotics.

Acidifiers as organic acids have been used for decades in feed preservation and they have been found valuable in the control of salmonella in feed and water supplies of livestock and poultry because of their bacteriostatic effects [11]. Acidifiers are believed to promote normal gut flora, enhance gut integrity, improve performance and productivity [12], promote digestive processes, and enhance nutrient absorption [13] thus reducing cost of medication.

Inclusion of 1-4% blood meal in diet have been reported to improve poultry performance [14,15] while [16,17] reported no adverse effects of higher levels of dietary blood meal on chicken growth. Also, attributed to the use of dietary acidifier is decreased colonization of gut pathogenic bacteria and improved digestibility of nutrients [18,19]. There had been earlier report [20] on performance and carcass characteristics of broiler chickens on acidified blood meal-based diets. Despite several works [21,22,23,15,16,17] being carried out on sole use of either acidifier or blood meal in broiler production, there is paucity of information on the use of acidifier in blood meal-based diets for broiler chicken. This experiment was therefore, aimed at investigating the effect of dietary acidifier on haematology and serum biochemical indices of broiler chickens fed blood-meal based diets.

2. MATERIALS AND METHODS

This experiment was carried out at the Teaching and Research Farms, University of Ibadan for 8 weeks. Blood meal was sourced from a reputable Feedmill at Bodija, Ibadan. A commercial acidifier (Biotronics SE) was purchased and was used at an inclusion rate of 0.3% of the diets.

2.1 Experimental Design

A total of 180 one-day old, broiler chicks were randomly allotted to four treatments of three replicates each with 15 birds per replicate. Detailed dietary experimental composition has been earlier reported [20]. Birds were raised on a broiler starter diet (Table 1) devoid of blood meal for the first four weeks and subsequently placed on a finisher ration for another four weeks. The finishers ration comprised four diets (Table 2). The control diet (T_1) had no blood meal and

acidifier, T_2 had both blood meal and acidifier, T_3 had blood meal only while T_4 had acidifier only. The birds were given feed and water *ad-libitum* for the duration of the experiment.

Table 1. Composition (%) of basal diet fed to starter broiler chickens

Ingredients	Starter diet (%)
Maize	50.00
Soybean	38.00
Palm oil	2.00
Wheat offal	7.24
Table salt	0.25
Oyster shell	0.50
Di-calcium phosphate	1.50
DL Methionine	0.15
L-Lysine	0.05
*Vitamin-Min Premix	0.25
Avatec	0.06
Total	100.00
Calculated values	
Crude protein	22.08
Metabolizable energy	2890.00

***vitamin premix composition per tone of diet. Vitamin A; 10,000,000 IU, Vitamin D3: 2,000,000 IU, Vitamin E: 40 mg, Vitamin K3: 2 mg, Vitamin B1: 1.5 mg, Vitamin B2: 5 g, Vitamin B6: 2.5 g, Vitamin B12: 20 mg, Niacin: 25 g, Calpan: 9 g, Folic acid: 1 g, Biotin: 100 mg, Anti-oxidant: 100 g, Manganese: 80 g, Iron: 40 g, Zinc: 60 g, Copper: 8 g, Iodine: 1 g, Cobalt: 300 mg*

2.2 Blood Collection

At week 8, three birds per replicate, previously starved of feed for 12 hours were randomly selected for blood collection. Blood was collected from the jugular vein into heparinized test tubes for haematology and another without EDTA for serum analyses. Haematological parameters; packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC) and differential counts were determined using standard procedures [24]. Serum indices; Total protein (TP) and albumin values were determined by Biuret method [25]. Globulin was estimated as the difference between total protein and albumin. Cholesterol [26], urea and creatinine were determined by the techniques of Harrison [27], serum enzyme (ALT and AST) activities were determined spectrophotometrically [28,29].

2.3 Statistical Analysis

Data were subjected to one-way analysis of variance using the statistical package [30]. Treatment means were compared using Duncan's multiple range test of the same software.

3. RESULTS AND DISCUSSION

The haematological parameters of experimental birds fed acidified blood meal-based diet are shown in Table 3. There were no significant differences ($P>0.05$) in the haematological parameters measured across the treatments. This result confirmed the findings of Hernandez et al. [31] that dietary organic acid supplementation had no effect on blood metabolites of broiler chickens in their study. Table 4 shows the serum biochemical indices of the experimental broiler finishers' birds. There were significant differences ($P<0.05$) in the serum composition of the experimental birds across the treatments. Increased level of AST is indicative of hepatic damage [27]. In this study, AST values for T1, T2 and T4 were similar ($P>0.05$) while that of T3 was significantly different ($P<0.05$) from the control. It was also observed that dietary inclusion of acidifier (T2 and T4) did not affect AST values when compared with the control. This however**,** was contrary to reports [32] where level of AST was reduced by dietary supplements of citric acid. However, reported enhanced AST activity occurred [33] with supplementation of citric acid. Reduced AST value observed in serum of birds on T3 indicated that blood meal had no negative effect on the liver of the birds. The ALT values obtained in this study were not significantly ($P>0.05$) affected by the different treatments thus**,** further confirming that the treatments were not damaging to the liver. A similar report was obtained for ALT concentrations in laying chickens fed acidified diets [21].

Acidifier supplemented groups had relatively higher levels of TP that were not significantly different from one another, however birds on T_2 (acidifier + blood meal) had significantly higher ($P<0.05$) TP than the control group. This possibly might be as a result of the high crude protein content of blood meal and synergy of acidifier in enhancing digestibility and absorption of protein. Digestion of protein as well as absorption of minerals in broilers [34] has been reported to be enhanced by supplementation with acidifier. Birds on sole supplemental organic acids T4 had TP that was similar to T1. This was in line with reported [35,36] insignificant difference in serum total protein concentration of broilers fed acidified diets. T_2 was not

Table 2. Composition (%) of experimental diets fed to finishers broiler chickens

Ingredients (%)	I	II	III	IV
Maize	50.00	50.00	50.00	50.00
Soybean	30.00	26.00	26.00	26.00
Palm oil	2.00	2.00	2.00	2.00
Wheat offal	15.24	16.94	17.24	18.94
Table salt	0.25	0.25	0.25	0.25
Oyster shell	0.50	0.50	0.50	0.50
Di-calcium phosphate	1.50	1.50	1.50	1.50
DL Methionine	0.15	0.15	0.15	0.15
L-Lysine	0.05	0.05	0.05	0.05
*Vitamin-Min. Premix	0.25	0.25	0.25	0.25
Avatec	0.06	0.06	0.06	0.06
Blood meal	-	2.00	2.00	-
**Biotronics SE®	-	0.30	-	0.30
Total	100.00	100.00	100.00	100.00
Calculated values				
Crude protein	19.52	19.57	19.60	18.21
Metabolizable energy	2793.00	2774.86	2778.60	2743.08

*. *vitamin premix composition per tone of diet. Vitamin A; 10,000,000 IU, Vitamin D3: 2,000,000 IU, Vitamin E: 40 mg, Vitamin K3: 2 g, Vitamin B1: 1.5 g, Vitamin B2: 5 g, Vitamin B6: 2.5 g, Vitamin B12: 20 mg, Niacin: 25 g, Calpan: 9 g, Folic acid: 1 g, Biotin: 100 mg, Anti-oxidant: 100 g, Manganese: 80 g, Iron: 40 g, Zinc: 60 g, Copper: 8 g, Iodine: 1 g, Cobalt: 300 mg.*

*** 17.4% Formic acid, 14.1% Ammonium propionate, 12.4% Propionic acid, 8.4% Ammonium Oligosaccharide as carrier*

Table 3. Haematological parameters of broilers fed acidified diet

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	SEM
PCV (%)	32.00	29.78	30.67	29.56	1.05
RBC (10^6/µL)	260.11	265.44	280.22	285.78	19.08
WBC (10^6/µL)	15727.78	16473.33	17527.80	16555.56	577.41
HB (g/dL)	10.66	9.92	10.22	9.85	0.35
MCHC (%)	33.31	33.29	33.32	33.32	0.01
MCV (fl)	1.29	1.15	1.17	1.12	0.11
MCH (pg)	0.43	0.38	0.39	0.36	0.04

MCHC - Mean Cell Haemoglobin Concentration, MCV - Mean Cell Volume, MCH - Mean Cell Haemoglobin, RBC - Red Blood Cell, PCV - Packed Cell Volume

Table 4. Serum indices of broilers fed acidified blood meal diets

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	SEM
AST (I.U/dL)	49.46^{a}	42.53^{ab}	29.77^{b}	41.76^{ab}	5.90
ALT (I.U/dL)	8.32	8.30	7.74	8.29	0.20
Total Protein (g/L)	5.19^{b}	5.71^{a}	5.52^{ab}	5.33^{ab}	0.13
Globulin (g/L)	3.67^{b}	4.28^{a}	3.47^{b}	3.88^{ab}	0.17
Cholesterol (g/L)	98.27^{b}	124.09^{a}	100.97^{b}	110.78^{b}	9.33
Uric acid (I.U/dL)	3.36^{b}	3.97^{ab}	4.25^{a}	4.46^{a}	0.25
Creatinine (mmol)	0.86	0.83	0.83	0.83	0.03
Albumin (g/L)	1.52^{b}	1.53^{b}	2.05^{a}	1.46^{b}	0.12

Means within the same row with different superscript (s) are significantly different (P < 0.05)
AST - Aspartate amino transaminase, ALT - Alanine amino transaminase

significantly different from T_4 but significantly different from T_1 and T_3 for globulin. Globulin level is an indicator of body defense mechanism [23]. The high level of globulin observed in T2 was an indication of improved immune response which could be linked to the presence of dietary acidifier. There has been similar report [13] of increased globulin in broiler chicks on supplemental citric and acetic acids. Sera albumin of birds on T_1, T_2 and T_4, were similar

while those on T_3 (blood meal only) had significantly higher albumin levels. This implies that addition of acidifier to blood meal diet (T2) as well as sole inclusion of acidifier in the diet (T4) did not affect albumin values but blood meal based diet improved albumin levels of the birds.

The cholesterol content of birds serum in T_4 (acidifier only) as observed in this study was not significantly different from those on control. This observation was supported by report [34] of no significant difference in cholesterol content of laying birds on acidified diets. Birds on T_2 however, recorded a significantly higher level of cholesterol concentration. This observation could possibly be best explained by the inclusion of blood meal in the ration of birds in the group as significant reduction in serum cholesterol of birds fed acidified diets has previously been reported [22].

Uric acid is the major end product of protein metabolism in poultry. Reported [37] reduced serum uric acid concentration when acid was added to the diets of broilers has been made. This report however contradicts observation from this study where diet with blood meal and acidifier (T2) was similar to the control (T1) while birds on T3 (blood meal only) and T4 (acidifier only) had elevated serum uric acid compared to the control. The reduced concentration of uric acid in broilers on T1 and T2 indicated better protein utilization by birds on those treatments. Creatinine levels in the serum were however not significantly ($P>0.05$) influenced by dietary acidification thus indicating that there was no renal damage or muscle wastage that is attributable to the dietary inclusion of acidifier in the diets of chickens used in this study. This observation was corroborated by report [38] of no changes in creatinine levels of broiler chickens fed diets containing organic acid.

4. CONCLUSION

Dietary acidification of blood meal based diets for broiler chickens had no influence on observed haematological parameters. Serum analyses however revealed better utilization of protein and improved health status evident in the total protein and globulin levels of the acidified blood meal-based group. Therefore, combined use of 0.3% Biotronics SE acidifier in 2% blood meal was most favourable to haematological and serum profiles. Further research should be conducted to ascertain the synergistic effect of blood meal and acidifier appropriate for broiler chicken production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ndelekwute GK, Uzegbu HO, Abdu LS. Digestibility and haematology parameters of broilers fed blood meal as a replacement for synthetic lysine. Global J. Pure Applied Sci. 2008;25(1):21-26.
2. Oluyemi JA, Roberts FA. Poultry production in warm wet climates (2nd Ed). Spectrum Books Limited, Ibadan, Oyo State, Nigeria. 2000;244.
3. Hinrichs J, Steinfeld H. Feed availability inducing structural change in the poultry sector. Proceedings of the International Conference on Poultry in the 21st Century Avian Influenza and Beyond, November 5-7, FAO, Bangkok, Thailand; 2007.
4. D'Souza D, Bourne S, Sacranie A, Kocher A. Global feed issues affecting the Asian poultry industry. Proceedings of the International Conference on Poultry in the 21st Century Avian Influenza and Beyond, November 5-7, FAO, Bangkok, Thailand. 2007;1-4.
5. Tabinda K, Khan SH, Ansari NN. Effect of different levels of blood meal on broiler performance during two phases of growth. Int. J. Poult. Sci. 2007;6(12):860-865.
6. Ra'fat SN. The effects of partial replacement of soybean meal in the grower diet with sun-dried blood and boiled feather meals on the performance of broiler chicks. An unpublished M.Sc. Thesis of Animal production Unit, Faculty of Graduate studies, An-Najah National University, Nabus, Palestine; 2008.
7. Ochetim S. The effect of partial replacement of soybean meal with boiled feather meal on the performance of broiler chickens. AJAS. 1993;6:597-600.
8. Donkoe A, Atuahene CC, Anang DM, Ofori SK. Chemical composition of solar dried blood meal and its effect on performance of broiler chickens. Anim. Feed Sci. Technol. 1999;81:299-307.
9. NRC. National Research Council. National requirements of poultry. 9th Rev. Edn., National Academy Press, Washington, DC. USA; 1994.

10. Ali MA, Nawab NN, Rasool G, Saleem M. Estimates of variability and correlations for quantitative traits in *Cicer arietinum* L. J. Agric. Social Sci. 2008;4(4):177-179.
11. Thompson JL, Hinton M. Antibacterial activity of formic and propionic acids in the diet of hens on salmonellas in the crop. Brit. Poult. Sci. 1997;38:59-65.
12. Tung CM, Pettigrew JE. Critical review of acidifiers. National Pork Board; 2006. Available:http://www.pork.org/Documents/PorkScience/ReviewOfAcidifiers.pdf (Accessed 25 April 2014)
13. Abdo MA. Efficacy of acetic acid in improving the utilization of low protein- low energy broiler diets. Egypt. Poult. Sci. 2004;24:123-141.
14. Richards JD, Gong J, Delange CEM. The gastrointestinal microbial and its role in monogastric nutrition and health with an emphasis on pigs; current understanding possible modulations and new technologies studies. Can. J. Anim. Sci. 2005;85:421-435.
15. Anang D, Atuahene C, Donkoh A, Koomson B, Oppong H. Further studies on the use of solar-dried blood meal as a feed ingredient for poultry. J Anim Feed Sci. 2001;10:159-167.
16. Donkoh A, Anang D, Atuahene C, Hagan M. Influence of processing temperature on chemical composition of solar-dried blood meal and on performance of broiler chickens. J Anim Feed Sci. 2002;11.
17. Khawaja T, Khan SH, Ansari NN. Effect of different levels of blood meal on broiler performance during two phases of growth. Int J Poult Sci. 2007;6:860-8655.
18. Kirchgessner M, Roth MX. Ergotrope Efekte durch organische suaren in der Ferkelaufzucht and Schweinemast. Ubersichten zur Tieremahrung. 1988;16: 93-108.
19. Veeramani P, Selvan ST, Viswanathan K. Effect of acidic and alkaline drinking water on body weight gain and feed efficiency in commercial broiler. Int. J. Poult. Sci. 2003;38:42-44.
20. Abu OA, Ogunwole OA, Adedeji BS, Akinboboye AVK, Tewe OO. Growth and carcass characteristics of finishing broilers on acidified blood meal based diet. African Journal of Livestock Extension. 2013;11: 11-14.
21. Amani W, Youssef EF, El-Daly NA, Abdel-Kazeem F, El-Monairy MM. Effect of sodium formate on laying hen performance, gastrointestinal tract pH and some blood components under heat stress conditions. Asian J. Poult. Sci. 2013;7(1): 17-26.
22. Abdel-Fattah SA, El-Sanhoury MH, El-Mednay NM, Abdel-Azeem F. Thyroid activity, some blood constituents, organs morphology and performance of broiler chicks fed supplemental organic acids. Int J. Poult Sci. 2008;7(3):215-222.
23. Kabir MA. Blood chemistry analyses of Japanese quail (Coturnix coturnix Japonica). Journal of Agricultural Science. 2013;3(4):132-136.
24. Schalm OW, Jain NC, Caroll EJ. Veternity haematology. 3rd Edn., Lea and Fabiger, Philadelphia. 1975;15-218.
25. Reinhold JG. Standard methods of clinical chemistry. Edited by Reiner, M. Academic Press, New York. 1953;1:88.
26. Roschlan P, Bernet E, Gruber W. Ezymatische best immungoles gesamt Cholesterius in serum. J. of Clin. Chem. and Biochem. 1974;12:403-407.
27. Harr KE. Diagnostic value of biochemistry. In: Harrison GJ, Lightfoot TL, editors, Clinical Avian Medicine. 2006;2. Available:www.clinicalavianmedicine.com
28. Hoder M, Rej R. Alanine transaminase. In: Methods of enzymatic analysis. 3rd ed. H. Bergmeyer U, Bergmeyer I, Grassl M, (eds). Weinhen Velag-Chemie; 1983.
29. McComb RB, Bowers GN, Rosen S. Alkaline phosphate. Plenum Press, New York; 1983.
30. SAS SAS/STAT User's Guide for personal computers. Version 8 Edition. SAS Institute Inc. Cary, NC; 2000.
31. Hernandez F, Garcia V, Madrid J, Orengo J, Catala P, Megias MD. Effect of acid on performance, digestibility, intestinal histomorphology and plasma metabolite levels of broiler chicken. Br. Poult. Sci. 2006;47:50-56.
32. Abdel-Azeem F, El-Hommosany YM, Nematallah GM. Effect of citric acid in diets with different starch and fibre levels on productive performance and some physiological traits of growing rabbits. Egypt J. Rabbit Sci. 2000;10:121-145.
33. Aktaç TA, Kaboglu A, Bakar E, Karacas H. The short term effects of single toxic dose of citric acid in mice. J. Cell Mol. Biol. 2003;2:19-23.

34. Gauthier R. Intestinal health, the key to productivity (The case of organic acids) XXVII convention ANECA-WPDSA Puerto Vallarta, Jal. Mexico; 2002.
35. El-Kerdawy DMA. Acidified feed for growing rabbits. Egypt. J. Rabbit Sci. 2002;6:143-156.
36. El-Hakim ASA, Cherian G, Ali MN. Use of organic acid, herbs and their combination to improve the utilization of commercial low protein broiler diets. Int J Poult Sci. 2009;8:14-20.
37. Sturkie PD. Avian physiology. 4th Edn. Springer-Verlag, INC, New York, N.Y; 1986.
38. Azza MK, Naela MR. Effect of dietary supplementation of organic acids on performance and serum biochemistry of broiler chicken. Nature and Science. 2014;12(2):38-45.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/17518