Nigerian J. Anim. Sci. 2018, 20 (4): 631-639

Effect of hot red peppers on blood chemistry and economics of broiler production

Egbewande, O.O.

Department of Animal Production, Ibrahim Badamasi Babangida University, Lapai.

Corresponding Author: *femi2015.ooe@gmail.com* ***Phone No.:*** *+2347068233925*

Target audience: *Poultry Farmers, Extension Agents, Researchers, Poultry Nutritionists*

Abstract

One hundred and fifty (150) day old (Marshal) broiler chicks were allotted into five treatments of three replicates each in a completely randomized design (CRD). The study which lasted eight weeks was undertaken to find out the effect of replacing vaccines with hot peppers: Avenir (*Capsicum chinense*), *black pepper* (*Pepper nigrum*), *Aji Blanco Crystal* (*Capsicum annum)*, and *Cayenne long slim* (*Capsicum baccatum)in the blood chemistry and economics of producing broiler chickens. The birds were fed with addition of hot peppers at inclusion rate of 20g per kilogram of compounded diet in this order: T_1 without pepper (control), T_2 plus Capsicum chinense (Avenir), T_3 plus Pepper nigrum (black pepper), T_4 plus Capsicum annum (Aji blanco crystal), and T_5 plus Capsicum baccatum (cayenne long slim). At the end of the 8 weeks data were collected on blood parameters which were subjected to analysis of variance (ANOVA) and separated using Duncan's Multiple Range Test (DMRT) at 5% probability level. The haematological parameters showed significant ($P<0.05$) differences among treatments except Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC). There were significant ($P<0.05$) differences in the serum parameters except cholesterol. The economics of production revealed that birds fed Capsicum annum (T_4) gave the highest gross profit (₦1547.53), while those in T_1 gave the lowest (₦812.19). This research revealed that using pepper, especially Capsicum chinense as a replacement for vaccine in broiler diets had no adverse effects on blood chemistry and gave better cost of production of the birds.*

Keywords: Blood chemistry, Pepper, Broiler, Economics of production

Description of Problem

It is no more news that many people are breaking away from the intake of meat and dairy products, because of chemicals ingested by livestock and poultry birds especially in the area of vaccines. According to (1), many countries have currently banned the use of drugs including antibiotics as growth promoters due to side effect on animals and human. Attempts have arisen therefore, in search of alternatives to drugs and vaccines in animal production practices, especially use of additives of plant origin, which are natural and safe to consumers (2).

Vaccines and drugs are being used in conventional poultry production. In fact, they are allowed in organic poultry production to prevent diseases. However, with the use of the vaccines many poultry farmers still encountered great losses. In Nigeria, many vaccines are already dead before reaching farmers either due to storage or transportation from the point of purchase to the farm. Also of importance is the costs of vaccines which add

to already high cost of poultry production. Therefore, if we are to do away with vaccines and invariably reduce cost of production then, the use of natural treatment is of necessity.

In recent times, the use of antibiotics in poultry production has become undesirable due to the meat product residuals (3), and development of antibiotics resistant bacteria population in human (4). To improve performance in production therefore, supplementation of natural components in place of vaccines in poultry production is to be considered.

(5) reported that piperine, an active component of black pepper, enhances the thermogenesis of liquids and accelerates energy metabolism in the body and also increases the serotonin and beta-endorphim production in the brain. It is also found that pepper has antioxidant properties and anti-carcinogenic effect (6). Among its chemical and biological activities, piperine is characterized by antimicrobial and anti-inflammatory properties. *Capsicum* species can either be used fresh or dried, whole or ground, but the level of hotness of the *Capsicum* species depends upon the concentration of capsaicin. Capsicum peppers are important food ingredients, and also clearly have nutritional and medicinal properties. (7) reported that the presence of the capsaicin in these species has long been associated with strong analgesic properties, alterations in the pH of gastrointestinal tract epithelial cells, prevention of microbial infection (8). It has also been shown that pepper species also contain peptides with strong antimicrobial activity and that these peptides are encoded in the pepper genome (9) and (10). Also of significance is that it lowers both blood cholesterol and triglycerides, but even more important is the lowering of the LDL-HDL ratio, the mechanism for this is not understood but blood serum cholesterol levels was significantly inhibited (11) and (12). It was on the above that four different hot peppers: Avenir (*Capsicum chinense*), black pepper (*Pepper nigrum*), Aji Blanco Crystal (*Capsicum annum)*, and Cayenne long slim (*Capsicum baccatum)* were used to replace vaccines in broiler production to assess the effect on blood parameters and economics of production.

Materials And Methods

Experimental site

The study was carried out at the Teaching and Research Farm of Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria, which is situated between Latitude $9^{o}31$ and $9^{o}45$ East of Equator (13). According to the author, the area falls within the Guinea Savannah Vegetation Zone of Nigeria with mean rainfall ranges between 1100 – 1600mm and mean temperature between 21^{o}C and 36^{o}C.

Sources of ingredients

The test ingredients used (hot pepper species), in this experiment were purchased from Minna Ultra Modern Market, Niger State, sun dried for six day in January when sun intensity was high, and grinded to powdery form. Maize was obtained in Lapai market, while wheat offal, bone meal, fish meal, groundnut cake, lysine, methionine, limestone and vitamin premix were obtained from Animal Care Shop, Gidan Matasa, Minna, Niger state.

Experimental diets

Chicks in T_1 were fed without any hot pepper (control) but vaccinated against infectious Bursal Disease and Newcastle Disease. Those in T_2 were fed with Avenir pepper (*Capsicum chennense*), T_3 fed with Black pepper (*Pepper nigrum*), T_4 fed with Aji blanco crystal pepper (*Capsicum annum*), while those in T_5 with Cayenne long slim pepper (*Capsicum baccatum*), at inclusion level of 20g per kilogram of compounded feed.

The broilers on hot pepper based diets were not vaccinated against Infectious Bursal Disease (Gumboro vaccine) and Newcastle disease (Lasota vaccine). The diets were formulated in such a way that they contained 23% and 2767.27kcal/kg and, 20% and 2794.61kcal/kg for crude protein and metabolizable energy in starter and finisher diets respectively, as presented in Tables 1 and 2.

Table 1: Gross composition of experimental starter diet

Ingredients (%)	Treatments				
	T_1	T_2	T_3	T_4	T_5
Maize	50.10	50.10	50.10	50.10	50.10
Groundnut cake	34.00	34.00	34.00	34.00	34.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat meal	8.00	8.00	8.00	8.00	8.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Table salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Avenir	-	+	-	-	-
Black pepper	-	-	+	-	-
Capsicum annuum	-	-	-	+	-
Cayenne *baccatum*	-	-	-	-	+
Total	100.00	100.00	100.00	100.00	100.00
Calculated:					
Crude protein (%)	23.41	23.41	23.41	23.41	23.41
ME (kcal/kg)	2767.27	2767.27	2767.27	2767.27	2767.27

*Flomix Mineral-Vitamin premixes of 0.25kg contains vitamin A 10,00mg, Vitamin D3, 2,000mg, Vitamin B1 500mg, Vitamin B2 5,000mg, Vitamin B6 300mg, Vitamin B12 10,000mg, Pantothenic Acid 10,000mg, Niacin 25,000mg, Folic Acid 1,000mg, Biotin 100,000mcg, Choline 150,000mg, Antioxidant 125,000mg and minerals such as Manganese 10,000mg, Zinc 50,000mg, Cobalt 250mg, Iron 40,000mg, Copper 6,000mg, Iodine 500mg and Selenium 100mg.

- = Absence of pepper, + = Presence of pepper

T_2 = Avenir pepper (*Capsicum chennense*), T_3 = Black pepper (*Pepper nigrum*), T_4 = Aji blanco crystal pepper (*Capsicum annum*), T_5 = Cayenne long slim pepper (*Capsicum baccatum*)

Table 2: Gross composition of experimental finisher diets

Ingredient (%)	Treatment				
	T_1	T_2	T_3	T_4	T_5
Maize	56.40	56.40	56.40	56.40	56.40
Groundnut cake	25.40	25.40	25.40	25.40	25.40
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat offal	10.3	10.3	10.3	10.3	10.3
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Avenir	–	+	–	–	–
Black pepper	–	–	+	–	–
Aji blanco crystal	–	–	–	+	–
Cayenne *baccatum*	–	–	–	–	+
Total	100.00	100.00	100.00	100.00	100.00
CP (%)	20.31	20.31	20.31	20.31	20.31
ME (kcal/kg)	2794.61	2794.61	2794.61	2794.61	2794.61

*****Flomix Mineral-Vitamin premixes of 0.25kg contains vitamin A 10,00mg, Vitamin D3, 2,000mg, Vitamin B1 500mg, Vitamin B2 5,000mg, Vitamin B6 300mg, Vitamin B12 10,000mg, Pantothenic Acid 10,000mg, Niacin 25,000mg, Folic Acid 1,000mg, Biotin 100,000mcg, Choline 150,000mg, Antioxidant 125,000mg and minerals such as Manganese 10,000mg, Zinc 50,000mg, Cobalt 250mg, Iron 40,000mg, Copper 6,000mg, Iodine 500mg and Selenium

– = Absence of pepper,+ = Presence of pepper

T_2 = Avenir pepper (*Capsicum chennense*), T_3 = Black pepper (*Pepper nigrum*), T_4 = Aji blanco crystal pepper (*Capsicum annum*), T_5 = Cayenne long slim pepper (*Capsicum baccatum*)

Capsicum chennense

Capsicum baccatum

Capsicum annum

Pepper nigrum

Experimental birds and management

One hundred and fifty (150) day old broiler chicks of mixed sexes were used for the experiment at the poultry section of the Teaching and Research Farm, Ibrahim Badamasi Babangida University, Lapai. The chicks were randomly assigned into five dietary treatments in a completely randomized design (CRD). Each treatment was replicated thrice with ten chicks per replicate. The pen

was washed, cleaned and disinfected with germicide (Izal) before the commencement of the experiment. Prior to the arrival of the chicks litter materials (wood shavings) were spread on the floor. On arrival, feed and water mixed with anti-stress (glucose) were served immediately and the temperature of the brooding room was under control. Chargeable lamps were used as the source of the lighting and charcoal as source of heat during brooding. Litters were changed fortnightly. Vitalyte® was administered to the birds after every weighing. Feed and water were supplied *ad-libitum*. Feed intake and the body weight of the birds were recorded on weekly basis. Embazin forte® and antibiotics were administered in water and all the vaccines (Lasota and Gumboro) were administered as at when due to birds in treatment 1 (T_1). Oxy-tetracycline and Amprococ, were administered to the chicks via drinking water for 5 and 3 days respectively.

Data collection

At the end of the study, two birds from each replicate were randomly selected and starved of feed overnight, and weighed before slaughtering. The selected birds were bled through jugular vein and 2ml of blood were collected into bottles containing Ethylene Diamine Tetra-acetic Acid (EDTA) to determine the haematological parameters (packed cell volume, haemoglobin, white blood cell, and red blood cell). Blood samples meant for serum studies were collected into plane bottles (without anticoagulant) to determine serum total protein, albumin, cholesterol and globulin. The blood constants like mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular haemoglobin concentration (MCHC) were calculated according to the procedures of (14).

$$\text{Mean Corpuscular Haemoglobin (MCH)} = \frac{\text{Hb x 10}}{\text{RBC}}$$

$$\text{Mean Corpuscular Volume (MCV)} = \frac{\text{PCV x 10}}{\text{RBC}}$$

$$\text{Mean Corpuscular Haemoglobin Concentration (MCHC)} = \frac{\text{Hb x 100}}{\text{PCV}}$$

All feed ingredients acquired and processing activities involved were monetized and price per kg of each ingredient was determined for economic analysis. Veterinary care and miscellaneous (variable cost): This was calculated as the total amount of money spent on vaccines, drugs, day old chick and other expenses divided by the number of the birds. Average body weight (kg): This was the final body weight of the birds before slaughtering.
Price per feed: This was calculated by taking into consideration the individual ingredients used in compounding the diet. This is calculated by:
Price per (kg) feed = cost per (kg) of the diet
Total investment: was the total amount of money spent during the cause of production.
Gross returns: this was the live weight gain multiply by the price of chicken per kg.

Gross profit: this was the profit realized after the sales of the bird. It is given as gross return - total investment.

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) for a completely randomized design (CRD), according to the procedure of (15) using LSD for all means that were significantly different.

Results and Discussion

Results on haematological and serum parameters are presented in Tables 3 and 4 with the values showing significant ($P<0.05$) differences except in MCH, MCHC and MCV in haematology assay, and cholesterol in serum analysis. Birds fed with Avenir pepper had the highest RBC, haemoglobin and PCV, while those fed with black pepper exhibited highest WBC, MCH and MCHC. In serum analysis,

birds fed Avenir pepper recorded highest total protein, albumin and globulin, while those fed T_1 had the highest cholesterol (1.80), T4 gave the highest AST (100.47), and the highest ALP was among birds fed *Capsicum baccatum*.

Birds on Avenir indicated the superiority in parameters measured which is significantly ($P< 0.05$) different from all other treatments. Recorded PCV and haemoglobin values for birds fed with Avenir and black pepper are within the range reported by (16) which are (23.0-55.0) ml% and (7.0-18.0) g/dl respectively. Birds on Avenir also had the values for RBC and albumin within the ranges reported by (16) which are (4.01-4.54) and (1.3-6.5) respectively. The value recorded for WBC in birds fed Avenir is very close to the normal range (2.63-4.32) reported by the authors. The reduction of PCV, Hb and RBC values in birds fed black pepper may be due to the activity of the pepper which may acts on oestrogen hormone as reported by (17). The concentrations of total protein and albumin in birds fed with Avenir were significantly ($P< 0.05$) different from other treatments including the control group. The increase in total protein and albumin compared to the control showed that the birds fed with feed supplemented with Avenir pepper were not deficient in globulin. Also the increase in red blood cell showed that the birds were not aneamic, and reduction in WBC shows that they were not diseased since high concentration of WBC may indicate the presence of disease or infection which they (WBC) helps to fight. Higher concentrations of globulin recorded by birds fed Avenir and black pepper agreed with the report of (18) that peppers, especially black pepper, in broiler nutrition had influence on improved health status through increase of serum globulin concentration. Cholesterol levels decreased in birds fed peppers but increased in those in control. This is these results agree with the reports of (11) and (12) that pepper plays an important role in decreasing the deposit of cholesterol, fat and also supports the vascular system in the body. Aspartate Aminotransferase (AST) value is significantly ($P<0.05$) different and higher in T_4 than other treatments. AST values recorded in this study were higher than the report (30.31 – 37.77) of (19). The economics of production revealed that birds fed *Capsicum annum* (T_4) gave the highest gross profit (₦1547.53), while those in T_1 gave the lowest (₦812.19). This lowest gross profit recorded in T_1 might be connected to the costs of the vaccines compared to the costs of the peppers in other treatments (without vaccines).

Conclusion and Applications

It was concluded that:

1. Haematological and serum indices revealed that blood quality and the health of the birds were not compromised by the use of peppers to replace vaccines, especially in birds fed T_2 based on mortality percent
2. Better gross profits, as regards final live weights of the birds, were obtained from birds fed hot peppers than those fed the control. Therefore, the use of hot peppers in place of vaccines reduced cost of broiler production.

Table 3: Effect of test ingredients on haematological parameters of broiler chickens

Parameter	T_1	T_2	T_3	T_4	T_5	±SEM
White Blood Cell ($x10^9$/l)	1.69^{ab}	2.60^{a}	3.26^{a}	1.30^{b}	1.54^{ab}	1.06
Red Blood Cell ($x10^{12}$/l)	2.12^{b}	4.17^{a}	3.58^{ab}	2.04^{b}	1.79^{b}	1.05
Haemoglobin (g/dl)	0.60^{b}	11.07^{a}	9.58^{ab}	5.40^{b}	4.77^{b}	2.81
Packed Cell Volume (%)	17.00^{b}	33.33^{a}	28.67^{ab}	16.33^{b}	14.33^{b}	8.42
MCH (pg)	2.83	26.54	26.76	26.47	26.65	0.49
MCV(fl)	80.19	79.93	80.08	80.05	80.06	3.21
MCHC (%)	3.53	33.21	33.41	33.07	33.29	2.14

^{ab}Means with different superscripts in the same row differs significantly (P<0.05) MCH = Mean corpuscular haemoglobin, MCV = Mean corpuscular volume, MCHC = Mean corpuscular haemoglobin concentration

Table 4: Effect of test ingredients on serum parameters of broiler chickens

Parameter	T_1	T_2	T_3	T_4	T_5	±SEM
Total protein (g/dl)	1.33^{ab}	2.37^{a}	1.27^{ab}	1.60^{ab}	1.17^{b}	1.06
Albumin (g/dl)	0.84^{bc}	1.37^{a}	1.25^{a}	0.92^{bc}	0.69^{c}	1.05
Globulin (g/dl)	6.60^{b}	10.09^{a}	8.99^{ab}	8.07^{b}	8.17^{b}	2.81
Cholesterol (mmol/l)	1.80	1.02	0.96	1.33	1.03	8.42
AST (iu/l)	78.83^{d}	91.54^{c}	91.76^{c}	100.47^{a}	98.65^{b}	0.49
ALP (iu/l)	100.19^{b}	101.03^{b}	101.58^{b}	102.45^{b}	108.06^{a}	3.21

^{abcd}Means with different superscripts in the same row differs significantly (P<0.05) AST = Aspartate Aminotransferase ALP = Alkaline Phosphate

Table 5: Cost analysis for broiler chickens fed test ingredients.

Parameter	Treatment				
	T_1	T_2	T_3	T_4	T_5
Final live weight (g)	1769.00	1910.00	1910.00	2240.00	2053.00
Mortality (%)	16.67	13.33	33.33	20.00	23.33
Cost of day old chick (₦)	200.00	200.00	200.00	200.00	200.00
Final weight gain (kg)	1.769	1.910	1.910	2.240	2.053
Cost of feed (₦/kg)	94.53	89.20	86.13	92.49	92.85
Total feed consumed (kg)	5.812	4.815	4.929	5.276	5.288
Total cost of feed consumed (₦)	549.41	429.50	424.53	487.98	490.99
Variable cost (₦)	466.67	373.33	366.67	360.00	366.67
Total investment (₦)	1310.61	1092.00	1077.33	1140.47	1150.51
Cost of bird /kg (₦)	1200.00	1200.00	1200.00	1200.00	1200.00
Gross return (₦)	2122.80	2292.00	2292.00	2688.00	2463.60
Gross profit (₦)	812.19	1200.00	1214.67	1547.53	1313.09

₦1200 per kg live weight

References

1. Khachatourian, G.G. (1998). Agricultural use of antibiotic and the evolution and transfer of antibiotic resistant bacteria. *Canadian Medical Association Journal.* 159:1129 – 1136.
2. Soliman, A.Z.M. (2003). Effect of *Marjoran bacitracin* active yeast as feed additive on the performance and microbial content of the broiler intestinal tract. *Egypt Poultry Science Journal,* 23 (11): 445 – 467.
3. Burgat V (1999). Residues of drugs of veterinary use in food. *Rev. Part.*, 41: 985-990.
4. Sahin, O., Morishita, T.Y. and Zhang, G. (2002). Campylobacter colonization in poultry: sources of infection modes and transmission. *Animal Health Research Reviews*, 3: 95-105.
5. Al-Kassie, G.A.M. and Witwit, N.M. (2010). A comparative study on diet supplementation with a mixture of herbal plants and dandelion as a source of prebiotics on the performance of broilers. *Pakistan Journal of Nutrition*, 9(1): 67-71.
6. Surh, Y.J. and S.S.Lee, (1995). Capsaicin, a double-edged sword: Toxicity, metabolism and chemopreventive potential. *Life Sci*iences, 56: 1845-1855.
7. Cordell, G.A. and O.E. Araujo (1993). Capsaicin: Identification, nomenclature, and pharmacotherapy. *Annals of Pharmacotherapy*. 27: 330-336.
8. Tellez,G.I., Jaeger, C.E., Dean, D.E. Corrier and J. R. Deloach, (1993). Effect of prolonged administration of dietary capsacin on *Salmonella* enteritis infection in leghorn chicks. *Avian Di*sease, 37:143-148.
9. Texeira, F.R., M.C.O.P. Lima, H.O. Almeida, R.S. Romeiro and D.J.H. Silva, (2006) Bioprospection of cationic antimicrobial peptides from bell pepper leaves for inhibition of *Ralstonia solanacearum* and *Clavibacter michiganesis* spp. Michiganesis growth. *Journal of Phytopathology*, 154:418-421.
10. Diz, M.S.S., A.O. Ccarvalho, R. Rodriguez, A.G.C. Neves-Ferreira, M.D. Cunha, (2006). Antimicrobial peptides from chili pepper seeds causes yeast plasma membrane permeabilization and inhibits the acidification of the medium by yeast cells. *Biochemistry Biophysics Acta,* 1760:1323-1332.
11. Sambaiah, K. and N. Satyanarayana. (1980). Hypocholesterolemic effect of red pepper and capsaicin. *Indian Journal of Experimental Biology*, 18: 898-899
12. Visudhiphan,S., S. Poolsuppasit, O. Pibolnukarintr, (1982). The relationship between high fibrinolytic activity and daily capsicum ingestion in Thais. American Journal of Clinical Nutrition, 35: 1452-1458.
13. Usman, B. A. (2013) Vulnerability and Adaptation Capability of the Rural poor to climate change Effect in Kwara State, Nigeria. *Lapai Sociological Review*, 4(1):142- 162.
14. Jain, N.C. (1986). Veterinary Haematology, 4th ed., Lea and Febiger Publishers, Philadelphia.
15. Gen Start Release 14.3DE (2014). VSN International Ltd. (Rothamsted Experiment Station).
16. Mitruka, B.M. and Rawnsley, (1977). Clinical, Biochemical and Haematological Reference Value in Normal Experimental Animals. Mason Publishing Company, New York.
17. Al-Kassie, G.A.M., Mamdooh, A.M., Al-Nasraw, S. and Ajeena J (2011). Use of black pepper (*Piper nigrum*) as feed additive in broiler diet. *Research Opinions in Animal and Veterinary Science*, 1(3): 169-173.

18. Abou-Elkhair, R., H.A. Ahmed and S. Selim, (2004). Effects of black pepper (P*iper nigrum),* Tumeric powder(*curcuma longa*) and coriander seeds (*coriandrum sativum*) and their combinations as feed additives on growth performance, carcass traits, some blood parameters and humoral immune response of broilers chickens. *Asian Australian Journal of Animal Science*, 27: 847-854.
19. Elamin, H.M.S., Mohamed, K.A. and Mukhtar, M.A. (2015). Effect of hot red pepper (*Capsicum frutescens*) on performance, abdominal fat and blood serum parameters of broiler. *Journal of Global Biosciences*, 4(5): 2251 – 2257.