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Response of Finisher Broiler Chickens Fed Graded Levels Of Bovine Blood Meal Diets On Growth And Blood Chemistry

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Abstract
A total of sixty (60) broiler chickens 4 weeks old were used in a 28-day study. The chickens were randomly assigned to four dietary treatments (T1, T2, T3 and T4) in a Completely Randomized Design (CRD). Each dietary treatment was replicated three times and each replicate had 5 chickens. T1 (Control diet) contained 0% BBM while T2, T3, and T4 contained 5%, 10% and 15%, respectively. Data were collected on the feed intake and weight gain. Feed conversion ratio, daily Protein intake, and Protein efficiency ratio were calculated. Haemoglobin counts, packed cell volume, red blood cell, white blood cell, neutrophils, lymphocytes, monocytes and eosinophils were analyzed. Feed cost/kg, feed cost/kg weight gain/bird/treatment, total cost of production, net returns, total revenue and Cost-benefit ratios were derived from the Analysis. Data collected were subjected to Statistical Analysis using One-way Analysis of Variance (ANOVA). Statistical mean differences were separated using the Least Significant Difference (LSD). Results show that all the haematological indices of the chickens in different treatment groups were not significantly (P>0.05) different. There was no significant ((P>0.05) difference in all the growth performance parameters of the chickens except the total feed intake and average daily weight gain. The cost-benefit Analysis results show that feed cost/kg gain and total cost of production decreased as the levels of BBM increased. It is therefore concluded that a 15% optimal dietary inclusion of BBM is adequate to enhance growth without any adverse effect on the health of broiler chickens.
Keywords: Bovine blood meal, Growth Performance, Haematology, Cost-benefit, Broiler Chickens

Introduction

The level at which animal protein is consumed directly influences the general well-being and health of the ever-increasing population (Bamgbose *et al*. 2002). Malnutrition, one of the major problems facing the world especially today is mostly associated with animal protein deficiency (Okon and Olayoyin, 2007). Thus there is an urgent need for the improvement of the protein status of the diets of Nigerians. Poultry production offers considerable potential for bridging the animal protein gap because of the high-yielding exotic poultry that is easily adaptable to our environment and their fast growth rate (Madubuike, 1992). Nutrition represents one of the most serious limitations to poultry production. The rising cost of poultry feeds has continued to be a major problem in Nigeria and other countries of Africa as feed cost occupies about 70-85% of the total cost of production (Madubuike, 1992) when compared to 50-60% in developing countries (Tackie and Fletcher, 1995). The poultry feed producers and animal nutritionists are faced with the task of finding alternative feed stuffs especially those that do not attract competition. Conventional ingredients are expensive because they suffer from stiff competition with channels in the food chain which command higher priority and can pay higher prices than the compounded feed. This scenario has greatly reduced the rate of expansion of the poultry industry in Nigeria which has further diminished the already low intake of animal protein of the populace (Madubuike, 1992). In an attempt to reduce the price of poultry feeds, efforts are made to utilize slaughterhouse wastes as feed ingredients (Javanovic and Cuperlovic, 1977). A major solution to the problem of rising costs and scarcity of energy and protein sources for monogastric farm animals is seeking new and non-conventional raw materials. The recycling of slaughterhouses as feed for various categories of livestock has been a continuous subject of investigation. Bovine blood meal is a slaughter product that provides a cheap source of livestock feed. It has been used in Nigeria to feed monogastric animals, especially poultry without any deleterious clinical effect on animal health and performance.

Materials and Methods

Experimental Site

The experiment was carried out at the Poultry Unit of the Department of Animal Science, Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki. Abakaliki lies approximately on latitude $7^0$30E and $8^0$30E and longitude $5^0$40N and $6^0$45N *(*Ofomata, 2000*)*, with an average temperature of 27.7^0C and an average rainfall of 1800mm.

Source and preparation of blood meal

Fresh bovine blood was collected from the slaughterhouse in Abakpa Meat Market in Abakaliki immediately after cattle were slaughtered. After collection, the blood was immediately boiled at 100^0C for about 45 minutes to let water evaporate and destroy pathogenic organisms. After boiling, it was dried at a low temperature of about 40-45^0C for about 3 days and ground in a mill into a meal that is suitable for incorporation into a poultry diet.

Experimental procedures

A total of 60 four (4) weeks-old broiler chickens (Aboacre) were used for the experiment. The birds were randomly allotted to four (4) dietary treatments in a completely randomized design (CRD). Each treatment was replicated 3times with five (5) birds per replicate. The birds were housed in a compartment measuring 1.5 mx 1.5 m^2 per replicate. They were fed *ad libitum* with a regular supply of clean drinking water throughout the experimental period. Routine poultry management and vaccinations (Newcastle disease and Gumboro) were administered at 2 and 3 weeks. The experiment lasted for 28 days.

Experimental Diets:

Four experimental diets were formulated such that Bovine blood meal was included as follows: Treatment 1 (0% - control), and 5%, 10%, and 15% dietary levels for Treatments 2, 3, and 4 respectively.

Data collection*:* Data was collected from the following Parameters

i. Feed intake
ii. Weight gain
iii. Feed conversion ratio
iv. Daily protein intake
v. Protein efficiency ratio

Feed intake

Each replicate was served with a weighed quantity of the feed and overfeed was collected per replicate group the previous day, weighed and recorded, the daily feed intake of each replicate group was determined by the difference between the feed served and the leftover feed.

Feed intake = total feed served – leftover feed

Weight gain

The Birds were weighed before the commencement of the experiment to obtain their initial body weight and subsequently weekly, using a weighing scale. At the end of the experiment, the body weight gain was determined by subtracting the initial body weight from the final body weight.

The average daily body weight gain was determined by dividing the body weight gain by the number of days of the experiment.

Weight gain = final body weight – initial body weight

$$\text{Daily body weight gain} = \frac{\text{Body weight gain}}{\text{Number of days of the experiment}}$$

Feed conversion ratio

Feed conversion ratio was calculated by dividing the average daily feed intake by the average daily weight gain.

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Average daily intake}}{\text{Average daily weight gain}}$$

Daily protein intake

Daily protein intake was determined by first calculating the daily feed intake and multiplying it with the percentage of crude protein in the feed.

$$\text{Daily protein intake} = \text{daily feed intake x} \frac{\text{CP}}{100}$$

Protein Efficiency Ratio (PER)

Protein efficiency ratio was calculated by using the value obtained from the daily protein intake to divide the daily weight gain of the birds.

$$\text{Protein efficiency ratio} = \text{daily feed intake x} \frac{\text{Daily body weight gain}}{\text{Daily protein intake}}$$

Blood collection and evaluation: At the end of the feeding trial, 2ml of blood sample was collected from 3 birds in each treatment: 1 bird from each replicate for the evaluation of haematological indices. The blood sample was collected through the wing veins using disposable syringes and needles. It was done in the morning to avoid excessive bleeding. The collection site was swabbed with cotton wool soaked in alcohol to avoid excessive bleeding. The blood sample was collected into sample bottles containing dipotassium salt of ethylene diamine tetraacetic acid (EDTA-K^{2+}) which served as anticoagulant. The blood sample was analyzed for: packed cell volume (PCV), total erythrocyte (RBC), haemoglobin (H_b) and differential leucocyte (WBC). Erythrocyte (RBC) count was counted in a haemocytometer chamber with Natt and Hardries diluents and obtained a 1:200 dilution. The number of leucocyte was estimated as total WBC x 200. Packed cell volume (PCV) was measured as micro haematocrit with 75 x 16cm^2 capillary tubes filled with blood and centrifuged at 300 r.p.m. for 5 minutes. The differential count of leucocytes was made from blood strained with Wright's dye and each type of cell was counted with a laboratory counter (Jain, 1986). Haemoglobin concentration (HBC) level was calculated according to Bush (MCH).

Cost-benefit analysis: The prevailing market price of the ingredients at the period of this experiment was used to calculate the cost of feed per kg (N), the total cost of feed consumed (N), the cost of daily feed intake (N), the cost of feed per kg weight gain (N) and cost savings (%).

$$\text{i. Feed cost (₦)/kg} = \frac{\text{Total cost of feed (₦)}}{\text{Total feed consumed /(kg)}}$$

ii. Total revenue generated = Final body weight x number of birds x cost per kg live weight

Statistical Analysis*:* Data collected from the parameters measured were subjected to Statistical Analysis using Analysis of Variance (ANOVA) in Completely Randomized Design (CRD) where significant differences were found, and the statistical means were compared and/or separated using the Least Significant Difference (LSD) as outlined by Obi (2002).

Growth Performance: The result of the effect of graded levels of bovine blood meal on the growth performance characteristics of Broiler chickens is presented in Table 2.

There was no significant difference (P<0.05) in the final body weight among the treatment groups. The highest mean value for the final body weight (1.42kg) was recorded from the birds on the control diet (T1), followed by birds on the T4 (1.31kg) and the T3 (1.30kg) diets respectively, while the lowest value (1.18kg) was recorded from the birds fed the T2 diet. The effect of bovine blood meal on the average daily feed intake was significant (P<0.05). The values (0.38kg, 0.45kg, 0.48kg and 0.53kg) increased progressively with the levels of inclusion of bovine blood meal. There was no significant (P>0.05) difference in the average body weight gain. The birds on the control diet (T1) had the highest value (0.97kg), followed by the birds on the T3 (0.88kg) and the T4 (0.79kg) diets respectively, while the birds on the T2 diet had the lowest value (0.77). The total feed intake was significantly (P<0.05) affected by the dietary treatment. The values (10.67kg, 12.49kg, 13.45kg and 14.73kg) increased in a linear order with the levels of inclusion of bovine blood meal. The average daily weight gain was significantly (P<0.05) affected by the dietary treatment. The birds on the control diet (T1) had the highest value (0.035kg), followed by the birds on the T3 diet (0.031kg), while the birds on the T2 and the T4 diets had similar values of 0.028kg, respectively which are the lowest among the treatment means. There were no significant (P>0.05) differences in the feed conversion ratio, daily protein intake and protein efficiency ratio. The highest mean value for the feed conversion ratio (18.93) was recorded from the birds on the T4 diet, followed by birds on T2 (16.07) and T3 (15.48) diets respectively, while the birds fed the control diet (T1) recorded the lowest value (10.86) among the treatments. The birds on the control treatment (T1) had the highest value (0.025kg) for daily protein intake, followed by the birds on the T2 (0.022kg) and the T3 (0.022kg) diets respectively, while the birds on the T4 diet recorded the lowest value (0.020kg). The highest mean values for the protein efficiency ratio (0.61) was recorded from the birds on the T2 diet, followed by the birds on the control diet (0.54), while the birds on the T3 and the T4 diets recorded similar values (0.51) which is the lowest among the treatment means.

Haematology

The haemoglobin count of the birds ranged between 7.73 g/dl and 7.80g/dl. The values dropped from 7.73g/dl in the birds fed the control diet (T1) to the lowest value (7.70g/dl) in the birds fed the T2 diet (5% bovine blood meal) and later increased to its highest value (7.80g/dl) at the T3 and the T4, respectively. The Packed Cell Volume (PCV) of the birds which ranged from 26.00 - 29.00% increased progressively with the inclusion levels of bovine blood meal to the diet of the birds. However, the birds fed the T4 diet (15% bovine blood meal) had the highest value (29.00%), while the birds fed the control diet (T1) had the lowest value (26.00%). Red Blood Cell (RBC) with the range of 1.61 x 10^{12}/l – 2.14 x 10^{12}/l followed the same trend as the Packed Cell Volume (PCV). The white blood cell (WBC) count which ranges from 3.06 x 10^{12}/l – 4.11 x10^{12}/l also followed the same trend as the PCV and WBC, respectively. Neutrophils with the range of 37.33% - 41.65% were highest (41.65%) in the birds fed the T3 diet (10% bovine blood meal) and lowest (37.33%) in the birds fed the T2 diet (5%BBM).Lymphocytes with the range of 56.67% - 61.33% were highest (61.33%) in the birds fed the T4 diet (15% bovine blood meal), and lowest (56.67%) in the birds fed the T3 diet (10% bovine blood meal) Monocytes with the range of 0.33% - 1.67% decreased progressively with the increasing levels of bovine blood meal's inclusion. Eosinophil with the range of 0.00% - 2.00% followed the same trend as the Monocytes.

Cost- Benefit Analysis

The result reveals that the cost of feed consumed by one bird in each treatment decreased progressively as the levels of dietary inclusion of bovine blood meal increased. The highest value (N175.20) was recorded from the control diet (T1), followed by the T2 (N174.62) and the T3 (N167.47) diets, respectively. The lowest value (N166.68) was recorded from the T4 diet. The cost of feed per kg body weight gain also decreased in a linear order with the increasing levels of dietary inclusion of bovine blood meal. The values (N140.26, N138.40, and N136.12) were lower in the bovine blood meal-based diets compared to the control diet (N144.24).The total cost of production also decreased linearly with the increasing levels of dietary inclusion of bovine blood meal. The values (N711.32, N692.00 and 690.00) were also lower in bovine blood meal-based diets compared to the control diet (N721.21).The total revenue generated from the selling of the birds were higher in the bovine blood meal-based (N1297.83, N1338.24, and N1302.24) compared to the control diet (N1294.80).The net returns followed similar trend as the total revenue. The cost-benefit ratio of the enterprise also decreased as the levels of inclusion of bovine blood meal increased. The highest mean value (1.26) was recorded from the birds fed the control diet (T1), followed by 1.18, 1.09 and 1.06 recorded from the birds fed the T2, the T4 and the T3 diets, respectively.

Result and Discussion

Growth Performance

The total feed intake of the birds increased significantly with the increasing levels of inclusion of bovine blood meal (Table 2). This result disagreed with Nwogwugwu *et al*. (2015) who reported that the total feed intake of the birds fed bovine blood meal decreased significantly with the increasing levels of bovine blood meal. According to these authors, the decrease in total feed intake is not surprising since the feed intake in chickens is inversely related to the dietary energy concentration (Tuleun *et al*., 2001). Bovine blood meal is high in energy and as the level of its inclusion increases in a diet, the metabolizable energy of the diet also increases (Tuleun *et al*., 2001). The final body weights (1.18kg, 1.30kg and 1.31kg) of the birds fed blood bovine meal were lower compared to 1.40kg obtained from the birds fed the control diet. The weight reduction could be attributed to very low levels of sulphur-containing amino acids and isoleucine which are responsible for the poor utilization of blood meal (Onwudike, 1981). The body weight gain of the birds increased linearly with the increasing levels of bovine blood meal inclusion (Table 2). This result is in agreement with Nwogwugwu *et al*. (2015) who reported that the body weight gain of birds increased linearly with the increasing levels of bovine blood meal and attributed the improved performance in body weight to high protein content of bovine blood meal.

They also attributed the improved performance in the body weight gain of birds fed bovine blood meal to long-chain fatty acids and partially digested feed protein material due to the influence of microbial protein (Okorie, 2005). Ekwuoma,(1992); Whyte and Wadak, (2002) and Esonu *et al*. (2004) also reported improved performance in the body weight gain of broiler chickens fed bovine blood meal and attributed it to adequate dietary crude fibre level. Kekeocha (1984); Esonu *et al*. (2001) and Esonu *et al*. (2004) reported that crude fibre activates the intestine and with more occurrence of peristatic movement, more enzyme production will occur which will result in efficient digestion of nutrients. The effect of dietary treatment on the feed conversion ratio of the birds was not significant (Table 2). This result is not in line with the findings of Bronz and Frigg, (1990) and Tuleun *et al*. (2001) who observed significant differences in the feed conversion ratio of broiler chickens fed diets containing graded levels of bovine blood meal. The result is also not in line with the reports of Ahmed *et al*. (2018) who reported significant differences in the feed conversion ratio (FCR) of the birds fed graded levels of slaughterhouse residue.

Haematology

The result presented in Table 3 indicated that bovine blood meal had no significant effect on the blood constituents of the birds. This result is in agreement with Ahmad *et al*. (1994), Dunkoh *et al*. (1999) and Odunsi *et al*. (1999) who reported that haematological parameters are unchanged in protein treatments. The result also agreed with Makinde *et al*. (2017) who reported no significant differences in the Packed Cell Volume (PCV), Red Blood Cell (RBC) and White Blood Cell (WBC) of broiler chickens fed Carmel blood meal (CBM). The result contradicted the findings of Shahidullah *et al*. (2008) who reported significant differences in the blood parameters of broiler chickens fed blood meal supplement. The slight increase in the Haemoglobin count (Hb), Red Blood Cell (RBC) and Packed Cell Volume (PCV) observed in this study is an indicator of good health condition of the birds fed bovine blood meal (BBM) based diets (Elangovane *et al*., 2001). The range (1.61-2.14 x 10^{12}/L) of RBC obtained in this study was lower than the normal range of (3- 6 x 10^{12}/L) for chickens (Madubuike and Ekenyem, 2006) probably due to species, age, sex, diets and clinical conditions of the birds as reported by Emenalum *et al*. (2009). These authors reported that the number of erythrocytes (RBC) of animals in good health condition varies with species, age, sex, diets and clinical conditions of the animals. The range of PCV (26.00 – 29.00) % from this study was within the normal range of (29 – 40) % reported by Siegmund (1979).

The slight increase in the lymphocyte count of the birds as the level of inclusion of bovine blood meal increased is an indicator that bovine blood meal can boost the immune system of the birds thereby reducing the likelihood of the birds being exposed to infectious diseases. Mitruka and Rawnsley (1977) stressed that higher lymphocytes and White Blood Cells (WBC) are associated with the ability of animals to perform well under very stressful conditions. The lower values of Eosinophils (1.00 1.00 and 0.00) % obtained from the birds fed bovine blood meal was an indicator that the anti-nutritional factors present in bovine blood meal did not affect the blood quality of the birds (Okosun *et al*., 2018).

Costs-Benefit Analysis

The results of the economic analysis presented in Table 4 show that the total cost/kg feed consumed by the birds in each treatment, feed cost/kg weight gain and total cost of production decreased with the increasing levels of inclusion of bovine blood meal. This is an indication that it was cheaper to feed broiler chickens with abattoir wastes such as blood meal than feeding them with conventional feedstuff. It is also an indicator that bovine blood meal is a cheap source of dietary protein in the diet of broiler chickens.

Conclusion

The use of bovine blood meal as an unconventional feedstuff in this study did not show any adverse health condition to the performance of the birds especially on their haematological and growth performance indices. The total feed intakes of the birds as well as their daily weight gain were significantly improved due to the inclusion of bovine blood meal to their diets. It was also observed from this study that the inclusion of bovine blood meal in the diet of the birds resulted in a significant cost reduction of animal production which will in turn increase the Returns On Investment (ROI) of the enterprise. It can therefore be recommended that up to a 15% inclusion of bovine blood meal can be used in the diet of broiler starter chickens without any deleterious effects on their growth performance characteristics and haematological indices.

References

Adedeji, O., Ajayi, J., Amao, A. and Aiyedun, O.(2013). Extent of commercial poultry production in Saki West local government area of Oyo State.

Transnational Journal of Science and Technology, 3(5): 68-81.

Adeniji, A. and Balogun O. (2002).Utilization of flavor treated blood-rumen content mixture in the diet of laying hens. *Nigeria Journal of Animal Production:* 29(1).58-76

Adeyemo and Longe (2007).Indicators of nutritional value of hydrolyzed feather meal. *Poultry Science:* 80:79-86.

Ahmed, M., Barque, A., Nawaz, H. and Siddique, R. (1994).Effect of varying energy and protein levels on the hematology of Japanese quails. *Pakistan Veterinary Journal*. 14: 200-202.

Akhter, S, Khan M, Anjum M, Ahmed S, Rizwan M. and Ijaz M. (2008). Investigation on the availability of amino acids from different animal protein sources in golden cockerels. *Journal of Animal and Plant Science*;18:53e4

Anang, D, Atuahene C, Donkoh A, Koomson B. and Oppong H. (2001). Further studies on the use of solar-dried blood meal as a feed ingredient for Poultry. *Journal of Animal Feed Science*; 10:159e67.

Babale, N., Choct, M. and Porter, M. (2012). Effects of feed enzymes on nutritive value of soyabean meal fed to broilers. *British Poultry Science :* 43:54e63.

Bamgbose, A., Abimbola, M, Olayemi, W., Orofonora O., OSO, A. and Ojo O. (2002); Proceeding of the 7th Annual Conference, of Animal Science Association of Nigeria (ASAN) University of Agriculture, Abeokuta, Nigeria.

Beski G., Parsons, C. and Stein, H. (2015). Nutritional value of soybean meal produced from conventional, high-protein, or low-oligosaccharide varieties of soybeans and fed to broiler chicks. *Poultry Science*; 90:390e5.

Broz J. and Frigg K. (1990). Influence of *Trichodermaviridae* enzyme complex on nutrient value of barley and oats for broilers. Archive Geflugelk: 54:34-37.

Castello A., Francino O., Cabrera B. and Polo J. S. (2004). Identification of bovine material in porcine spray-dried blood derivatives using the polymerase chain reaction. Biotechnology AgronSociety and Environment: 8:267-273.

Cmiljani R, Pavlovski Z, Trenkovski S. and Lukic M. (2003). New additives in Poultry nutrition. 7th International symposium on 'modern trends in livestock production' in Belgrade. Biotechnology of Animal Husbandry: 19:357 e62.

CmiljaniR, Pavlovski Z, Trenkovski S. and Luki M. (2005). New trends in poultry nutrition. Biotechnology of Animal Husbandry : 21:241e5

Dairo, N. and Zimmerman, D. (2006). The effect of thermal processing and enzyme treatments of soybean meal on growth performance, ileal nutrient digestibility, and chyme characteristics in broiler chicks. *Poultry Science*: 76:864e72.

Delgado, C., Rosegrant, W. and Meijer, S. (2001). Livestock to 2020: The revolution continues. Annual Meetings of the International Agricultural Trade Research Consortium (IATRC), Auckland, New Zealand, Citeseer. pp: 18-19

Denton J, Coon C, Pettigrew J. and Parsons C. (2005). Historical and scientific perspectives of same species feeding of animal by-products. *Journal of Applied Poultry Research*: 14: 352e61.

Donkoh, A., Atuahene, C., Anang, D. and Otori, S. (1999). Chemical composition of solar -dried blood meal and its effect on performance of broiler chickens.*Animal Feed Science and Technology*. 81(3-4): 299-307.

Ekwuoma, C. (1992). The Chemical Composition of rumen contents of cattle, sheep and goats B.Sc. Project report; University of Agriculture Abeokuta, Nigeria

Elangovane, G., Kuryszko J. and Stefaniak T. (2001). Use of spray-dried porcine blood by-products in diets for young chickens. *Journal of Animal/Physiology of Animal Nutr*ition: 96:319e33.

Emenalum, K.and Wiliczkiewicz, A. (2009). Chemical composition and biological values of spray-dried porcine blood by-products and bone protein hydrolysate for young chickens. *British Poultry Science:* 52:589e605.

Esonu, O. Azubike, C. Emenalom, O. Etuk, E. Okoli, C. Ukwu, O. and Nneji, C. (2004). Effect of Enzyme Supplementation on the performance of broiler finisher fed Microdesmis puberula leaf meal. *International Journal of Poultry Science*; 3:12-14.

Esonu, O. Iheukwumere, C. Iwuji, T. Akanu, N. and Nwugo, O. (2001). Evaluation of Microdesmis puberula leaf meal as feed ingredient in broiler starter diets.*Nigeria Journal of Animal Production*; 30:3-9.

FAO (2010).Poultry rations Fats and Proteins Research Foundation: www.rendermagazine.com.

FAOSTAT (2007). Better utilization of by-products from the meat industry. Food and Fertilizer Technology Center.

Field C, Johnson I. and Pratt V. (2000). Glutamine and arginine: immune-nutrients for improved health. Medical Science Sports Extract;32:S377e88.

Firman J and Robbins, D. (2004). Poultry rations. Fats and Proteins Research Foundation. www.rendermagazine.com

Friedhelm K.and Quigley J.(2002). Russell L. Impact of spray-dried bovine serum and environment on turkey performance. *Poultry Science:* 83:1683e7.

Han K. and Lee J. (2000). The role of synthetic amino acids in monogastric animal production. *Asian-Australia Journal of Animal Science*: 13:543e60.

Hassan, O., Mukhtar, M. and Nasir, S. (1974). The use of blood meal in tropical broiler diets. *Tropical Animal Health and Production.,* 6: 179-182.

Hazarika, M. (1994). Utilization of animal by-products as animal feed. Livestock Advances:19: 14.

Iheukwumere C. and Okoli, E. (2002). Application of new technologies in functional proteins for feeding calves. Ankeny, IA: APC Inc.

Jain, N. C. (1986). Schalman's Veterinary Haematology, 4th edition (Lea and Febiger Philadelphia) 224

Jamroz, D. Wiliczkiewicz, A, Orda J, Kuryszko J. and

Stefaniak, T. (2012).Use of spray-dried porcine blood by-products in diets for young chickens. *Journal of Animal /Physiology of Animal Nutrition*;96:319e33.

Jamroz, D, Wiliczkiewicz, A, Orda J, Skorupinska, J. and Kuryszko, J. (2011). Chemical composition and biological value of spray dried porcine blood byproducts and bone protein hydrolysate for young chickens. British Poultry Science;52:589e605.

Javanovic, M. and Cuperlovica, M. (1997). Nutritive value of Rumen content for Monogastric Animal feed science and Technology 2: 351-380.

Kekeocha, A. (1984). The use of soy protein in aquafeeds. In: Avances en NutricionAcuicola VI. Memorias del VI SimposiumInternacional de NutricionAcuicola, vol. 3; p. 175e91.

Khawaja, T. Khan, S. and Ansari, N. (2007). Effect of different levels of blood meal on broiler performance during two phases of growth. *International Journal of Poultry Science*: 6:860e5

Konwar, D. and Barman, K. (2005). Potential of utilization of Animal by-products in Animal feed. North East Vet: 5:28e31

Kughur, P. G. Daudu, S. and Onu, O. (2014).Factors affecting adoption of poultry innovation by rural farmers in Otukpo local Government area of Benue State, Nigeria. *International Journal of Livestock Research*, 4(8): 14-16.

Landes, M., Koomson, B. and Oppong, H. (2004).Further studies on the use of solar-dried blood meal as a feed ingredient for poultry. *Journal of Animal Feed Science* :10:159e67.

Liu D-C. (2002). Better utilization of by-products from the meat industry. Food and Fertilizer Technology Center.

Madubuike, F. N. (1989). The effects of inclusion of graded level of Brewers dried grains in the diets of early- weaned pigs

Makinde O., Vieira M, Ribeiro A, Kessler A. and Albino L. (2017). Inclusion of porcine spray-dried plasma in broiler diets. *Journal of Applied Poultry Research* ;22:229e37.

McDonald, P., Edwards and Greenhalgh, J. (1992). Animal Nutrition. 4th ed. Published in the United States with John Wiley and Sons. Inc. New York, pp: 455-483.

Moritz J. and Latshaw J. (2001). Indicators of nutritional value of hydrolyzed feather meal. Poultry Science: 80:79e86

Natural Research Council (NRC) (1994). Nutritional requirement for poultry 9th ed. National Academy Press Washington DC, USA

Nuarautelli, A., Anghinelli A. and Blanco, A. (987). Use of spray dried blood meal in broiler diet. MediciniaVeterinaria, Universita di Parma, Italy, pp: 333-353.

Nwogwugwu, N., Maxwell, C. and Spicer, L. (2015). Plasma protein for pigs weaned at 19 to 24 days of age: effect on performance and plasma insulin-like growth factor I, growth hormone, insulin, and glucose concentrations. *Journal of Animal Science*;73: 3657e65.

Obi, I. U. (2002). Statistical Methods of detecting differences between treatments means. 2nded Snaap Press, Enugu, Nigeria.

Odunsi, A, Farinu G, Akinola J. and Togun V. (1999). Growth, carcass characteristics and body composition of broiler chickens fed wild sunflower (*Tithoniadiversifolia)* forage meal. Tropical Animal Production Investigation 2: 205-11.

Odunsi, A., Onifade, A. and Babatunde, M. (1999).Response of broiler chicks to *virginiamycin* and dietary protein concentrations in the humid tropics. *Archivosdezootunia*. 48(183): 317-325

Ofomata, G.E.K. 2000. Nigeria in Maps: Eastern States. Ethiope Publishing House Benin City, Nigeria p. 52..

Okon, B. I. and Olayogin O. O. (2007). Evaluation of Rabbit performance on Millet bran as a replacement for wheat bran. Proceedings of the 32nd Annual conference of the Nigeria Society for Animal production Calabar 323-325

Okorie, K. C. (2005). The effect of Dried Pulverized Rumen content on the performance, Carcass and Organ characteristics of finisher broiler. Animal production Research Advances; 2(96-100)

Okosun, P. and Chrystal, P. (2018). Feeding the young broiler chicken in practice: a review of 23rd World's Poultry Congress. Brisbane, Australia.

Okunmadewa, F. (1999). Livestock Industry as a Tool for Poverty Alleviation. *Nigerian Journal of Animal Science*, 2(2): 21-30.

Oluyemi, A and Roberts, F. (2000). Poultry production in warm wet climate: Spectrum Books Ltd (Rev).

Onwudike, C.O. (1981). Effect of various protein sources on egg production in a tropical environment. Tropical Animal Production., 6: 249-256.

Oyawoye and Ogunkunle (2008). Efficacy of spray-dried bovine serum on health and performance of turkeys challenged with *Pasteurellamotucida*. *Journal of Applied Poultryt Research*;13:388e93.

Pearl, G. (2002). The future of animal protein in poultry diets. 2002

Petkov, S., Kacervsky, O., Sova, Z., Kalous, I., Slauk, L., Bouska, F., Jedlicka, Z., Stradel, M. and Parizokova, L., (1980). Possible part or complete replacement of animal meals by spray-dried blood from preserved or non-preserved blood in feeds for broilers. *PrazeFakulfaAgronomicka,* 31: 33-34. Nutrition. Abstract. Rev., 51:135.

Ravindran, V.(2013). Poultry feed availability and Nutrition in developing Countries: main ingredients used in Poultry feed formulations. Poultry development review. Rome, Italy: F. A. O.; p. 67e9.

Rim, (1993). Investigation on the availability of amino acids from different animal protein sources in golden cockerels. *Journal of Animal and Plant Science*;18:53e4.

Scanes, B., Trampel, W. and Campbell, J. (2004). Dietary spray-dried bovine plasma protein improves growth performance and breast-meat yield of broilers raised in a high-antigen environment. *Animal India Research*; 651:27.

Shahidullah, O., Atuahene C. and Hagan M. (2008). Influence of processing temperature on chemical composition of solar-dried blood meal on the performance of broiler chickens. *Journal of Animal Feed Science*: 11.

Siegmund (1979). Effect of different levels of blood meal on broiler performance during two phases of growth. *Intertional Journal of Poultry Science*. 6:860e5.

Skinner, C., Finamore, A., Cremokolini, C., Merialdi, G. and Trevisi, P. (1992). Effects of b-mannanase on broiler performance, gut morphology and immune system. *African Journal of Biotechnology.* 9: 6221e8.

Stein, H. (1996). The effects of adding spray dried plasma protein and spray dried blood cells to starter diets for pigs. In: *Simposlo Latino-Americano de nutricao de suinos e aves; p. 70e86.*

Subhadra, J. (2006). Effect of spray-dried bovine serum on intake, health, and growth of broilers housed in different environments. *Jurnal of Animal Science*; 81:2776e82.

Tackie, A. and Flenscher, E. (1995).Nutrition value of wild Sorghum Fortified with *Leacaena lencocephala*. Bulletin Animal Africa, 47:223-275.

Tuleun, C. Njoku, P. and Yaakugh, I.(2001).The performance of growing pullet fed *Roxazyme* in rice offal-based diets. Proceeding of the 26th Annual Conference of Animal Science Association of Nigeria, Zaria; 219-221.

Ufele, D. (2015). Potential of utilization of animal by-products in animal feed. North East Vet;5:28e31.

USDA Report,(2007).Ross 308 broiler management guide.Downloaded from: *www.aviagen. com*.

USDA (2013). Nutrient requirements of Poultry.9th rev.ed. Washington, DC: National Academy Press.

Whyte and Wadak (2002). Possible part or complete replacement of animal meals by spray- dried blood from Preserved or non-Preserved blood in feeds for broilers: 157-166pp.

Wishart (2002). Major anti-nutrients found in plant protein sources: their effect on nutrition. *Pakistan Journal of Nutrition*; 9:827e32.

Zarate, A. Moran, E. and Burnham, D. (2003).Reducing crude protein and increasing limiting essential amino acid levels with summer-reared, slow and fast-feathering broilers. *Journal of Applied Poultry Research*; 12:160e8

Table 1: composition of experimental diets

Ingredients	T_1(0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Maize	45.00	45.00	45.00	45.00
Soya bean meal	30.00	30.00	30.00	30.00
Wheat offal	8.00	8.00	8.00	8.00
Palmkernel cake	10.00	10.00	10.00	10.00
Fish meal	3.00	2.95	2.90	2.85
Blood meal	0.00	0.5	0.10	0.15
Bone meal	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Salt (Nacl)	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated Nutrients Composition				
Crude protein (%)	22.36	22.38	22.41	22.43
Crude fibre (%)	5.76	5.88	6.00	6.12
Metabolizable EnergyME (Kcal/Kg)	2782.2	2782.16	2782.11	2782.07

Table 2: growth performance of broiler chickens fed graded levels of bovine blood meal

Parameters	T1 (0%)	T2(5%)	T3(10%)	T4(15%)	SEM
Initial body weight (g)	0.45	0.41	0.42	0.53	0.011
Final body weight (kg)	1.42	1.18	1.30	1.31	0.026
Av. daily feed intake (kg)	0.38^{c}	0.45^{b}	0.48^{b}	0.53^{a}	0.018
Body weight gain (kg)	0.97	0.77	0.88	0.79	0.26
Total feed intake (kg)	10. 67^{ab}	12.49^{a}	13.45^{a}	14.73^{a}	0.49
Av. daily wt. gain (kg)	0.035^{c}	0.028^{b}	0.031^{a}	0.028^{b}	0.00062
Feed conversion ratio	10.86	16.07	15.48	18.93	0.103
Daily protein intake (kg)	0.025	0.022	0.022	0.020	0.00055
Protein efficiency ratio	0.54	0.61	0.51	0.51	0.037

abc = Means on the same row with different superscripts are significantly ($P<0.05$) different, SEM = Standard Error of the Mean.

Table 3: haematological indices of broiler chickens fed bovine blood meal diets

Parameter	T1(0%)	T2(5%)	T3 (10%)	T4 (15%)	SEM
Haemoglobin (g/dl)	7.73	7.70	7.80	7.80	0.084
Packed Cell Vol. (%)	26.00	27.33	29.00	29.00	1.27
Red Blood Cell (10^{12}/L)	1.61	2.07	2.11	2.14	0.075
White Blood Cell (10^{12}/L)	3.09	3.19	3.45	4.11	0.14
Neutrophils (%)	39.00	37.33	41.65	38.33	0.77
Lymphocytes (%)	57.67	60.33	56.67	61.33	0.81
Monocyte (%)	1.67	1.33	0.67	0.33	0.11
Eosinophil (%)	2.00	1.00	1.00	0.00	0.14

SEM = Standard Error of the Me

Table 4: Cost - analysis of feeding graded levels of bovine blood meal to broiler birds

Parameters	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)
Feed cost (N)/kg feed consu.	175.20	174.62	167.47	166.68
Feed cost (N)/kg weight gain	144.24	140.26	138.40	136.12
Total cost of production (N)	721.21	711.32	692.00	690.00
Total revenue (N)	1294.80	1297.83	1338.24	1302.24
Net returns (N)	573.59	586.51	646.24	612.24
Cost-benefit ratio	1.26	1.18	1.07	1.09

At the estimated total revenue of N1400.00 per bird.