American Research Journal of Agriculture
ISSN (Online) : 2378-9018
Volume 4, Issue 1, 10 Pages

AMERICAN RESEARCH JOURNALS
An Academic Publishing House

Research Article Open Access

Effect of Diamond V^{xpc} (Direct Fed Microbial) on Broiler Performance and Health Status

G. K. Sarfo[1,2], A. Donkoh[2], J. A. Hamidu[2]

[1]International Institute of Tropical Agriculture (IITA), Tamale-Ghana.
[2]Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
ogooduman@yahoo.com

Abstract: The experiment was conducted to assess the effects of probiotics (Diamond V^{XPC}) enriched feed on the growth performance of Hyberflex broiler breed. The experiment which lasted for 8-weeks involved 300 Hyberflex broiler chickens which were randomly assigned to 5 dietary treatments using a Compltely Randomized Design (CRD). Each treatment was replicated 3 times with 20 birds per pen. The Diamond V^{XPC} was incorporated into feed at varying levels up to 2% through feed. The treatments were designated T1, T2 and T3 with inclusion levels of 1.25, 1.5 and 2.0 kg/tonne respectively. A positive control (PC) which had the inclusion of 0.35kg/tone of Diamond V^{xpc} plus 0.35kg/tone of enerzyme and a negative control (NC) which contained zero (0%) Diamond V^{xpc} plus 0.35kg/tone of enerzyme. The parameters measured included; growth performance indices, carcass parameters and benefit cost analysis. Microbial data was also taken for total viable count and identification of bacteria in the small intestine of both the duodenum and ileum. The study revealed that adding Diamond V^{XPC} at 2% to the feed of broiler birds results in an efficient growth performance and a better weight gain. Also, adding Diamond V^{XPC} at 1.25 to 2% of the feed reduced feed intake and improved feed efficiency. It was more economical and efficient to raise broiler chickens at the inclusion level of 2% (T3) than any of the treatments in the study.

Introduction

Poultry production could be employed intensively as a short term solution for meeting the protein needs of people globally (Obi and Sonaiya, 1995). The local and intensive poultry producers are confronted by a number of challenges, pertinent among which are; high cost of feed, disease incidence, the extra cost incurred to solve these problems among others. Relatively paramount among these challenges is the incidence of diseases originating from viruses (Newcastle and Gumboro), bacteria (CRD) and protozoa (coccidiosis) (Appiah, 1993 and Koney, 1993). In an attempt to manage disease conditions, farmers often resort to administration of vaccines, antibiotics and coccidiostats to replenish the health status and increase the productive vigour of their birds (Aning, 2006).

Antibiotics, may lead to the evolution of resistant strains of microorganisms which become a lot more expensive and difficult to control (Dibner and Richards, 2005). Btter alternatives adopted in recent times to the use of antibiotics have been the efforts to reduce veterinary drugs, improving biosecurity measures and feeding of probiotics (Simon, 2005).

Probiotics are live microbes which when dispensed in satisfactory amounts confer a health benefit on the host (FAO/WHO, 2009). *Salmonella* microorganisms in chickens could competitively be excluded from the intestinal tract by the activities of probiotics (Wolfenden *et al.,* 2007). This can decrease the danger of diseases (Mounzouris *et al.,* 2009) and impact morphology and function of the digestion tract (Uscebrka *et al.,* 2005

and Yang *et al.,* 2009). In poultry, probiotics boost body weight by increasing digestion, assimilation (Kim *et al.,* 2003 and Salarmoini and Fooladi, 2011) and hinder the synthesis of cholesterol, with the goal that cholesterol levels drop and avoid arterosclerosis and coronary heart disease (Kim *et al.,* 2003).

Yeast probiotic improved body weight, feed intake and better feed conversion ratio in broiler chickens and also effectively inhibited the colonization of ceacal *Salmonella* and can replace antibiotics as growth promoters in commercial poultry farms (Olatoye *et al.*, 2014).

Diamond V^{XPC} is a probiotic with *Saccharomyces cerevisiae* as its main constituent and media on which it was grown, consisting of roughage products, processed grain by-products and cane molasses.

The general objectives of the experiment were to analyse the effect of probiotics enriched feed on broiler growth and carcass safety. The specific objectives were

1. To examine the effect of various inclusion levels of Diamond V^{XPC} on the growth performance of broilers.
2. To analyse the effect of Diamond V^{XPC} on internal viscera components of broiler birds and
3. To determine the effect of Diamond V^{XPC} on microbial status of the small intestine.

Materials and Methods

Experimental Location

The experiment was conducted at the Poultry Section of the Department of Animal Science, College of Agriculture and Natural Resources (CANR) of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. The area exists in the semi-deciduous backwoods zone of Ghana. The poultry area is situated within latitude 060 41'N and longitude 01''33'W. The highest temperature, least temperature and mean precipitation for the period were 31.5^{o}C, 20.6^{o}C and 14.0mm respectively.

The experiment lasted for eight weeks (56 days) and started in early October, 2017 and was terminated in December, 2017. Because of the non-existence of Animal Care Committee at the Kwame Nkrumah University of Science and Technology at the time of this experiment, the research was led and managed by the group leader following the experimental procedures affirmed by the University of Alberta Animal Care and Use Committee in accordance with the Canadian Council on Animal Care (2009) rules.

Experimental Animals and Experimental Design

Three hundred (300) day old hyberflex broiler chicks were used for the experiment. The day old chicks (DOCs) were acquired from Chicks and Chickens Hatchery, a local hatchery located at Entesery in the Ashanti Region of Ghana. There were five treatments and each treatment was replicated four times with fifteen (15) birds allocated to each replicate in a completely randomized design (CRD).

The birds were raised in twenty deep litter pens in an all-in-all-out system. The pens were used as brooding houses and heat supply was by incandescent bulbs (100 watts). Brooding temperatures were from 39-30ºC. Each pen measured 1.14m x 1.09m which gives a total floor space of 12.42m^2 with 15 birds per pen.

The birds were given unrestricted access to water and feed throughout the experimental period. Vaccine and medication were administered through the drinking water. The drinkers were cleaned each day and refilled whenever it dropped in level. The medication and vaccination programme used in the experiment is presented in Table 6.1.

Table6.1. *Vaccination and water program*

Day	Activity
1-4	Vitamins and Antibiotics and coccodiostats.
5-6	Pure water
7	First Gumboro
8-10	Pure water
11	Vitamins and Antibiotics and Coccidiostats
12-13	Pure water
14	First Newcastle vaccine
15	Pure water
16-18	Vitamins and Antibiotics and Coccidiostats
19-20	Pure
21	Second Gumboro
22	Pure
23-25	Vitamins and Antibiotics and Coccidiostats
26-27	Pure water
28	Second Newcastle vaccine
29	Pure water
30-32	Vitamins Antibiotics and Newcastle
33-41	Pure
42-46	Antibiotics
47-52	Pure water
53-57	Vitamins and Antibiotics and Coccidiostats

Dietary Treatments and Feeding

The birds were allotted to five dietary treatment diets, namely; positive control (PC), negative control (NC), treatment one (T1), treatment two (T2) and treatment three (T3). The NC diet had zero Diamond V^{XPC} and birds treated with antibiotics. PC had 0.35kg/ton of Diamond V^{XPC} and birds treated with antibiotics. T1 had 1.25kg/ton of Diamond V^{XPC} added to it (as the recommended level by the manufacturers). T2 had 1.50kg/ton of Diamond V^{XPC} added to it whilst T3 had 2.0kg/ton of Diamond V^{XPC} added to it. Apart from the PC, all the Diamond V^{XPC} treated birds received no antibiotics treatment.

The birds were place under two different dietary phases. The starter phase (day 1 to day 28) and the finisher phase (day 29 to day 56). Experimental diets were formulated to be isonitrogenious and isocaloric under both phases (Table 6.2 and Table 6.3) and meeting the nutritional requirements of Hyberflex broiler birds. The starter phase had 22.5% CP and 2891.80 kcal/kg of energy and 19% CP and 2,900kcal/kg of energy for the finisher stage.

Table6.2. *Percentage composition of the experimental diets at starter phase*

Ingredients (kg)	STARTER PHASE TREATMENTS[1]				
	NC	PC	T1	T2	T3
Maize	570.15	570	569.45	569.2	568.7
Fishmeal	40	40	40	40	40

Soybean meal	315	315	315	315	315
Wheat bran	30	30	30	30	30
Oyster shell	24	24	24	24	24
Bone meal	11	11	11	11	11
Salt	3	3	3	3	3
Vit. trace mineral premix	3	3	3	3	3
Lysine	1.9	1.8	1.8	1.8	1.8
Methionine	1.6	1.5	1.5	1.5	1.5
Enerzyme-select	0.35	0.35	-	-	-
Diamond V	-	0.35	1.25	1.5	2
TOTAL	1000	1000	1000	1000	1000
Nutrient composition (calculated)					
Crude protein, %	22.55	22.53	22.54	22.54	22.55
Ether Extract, %	3.58	3.58	3.58	3.58	3.58
Crude fibre, %	2.81	2.82	2.84	2.85	2.86
Calcium, %	1.30	1.30	1.30	1.30	1.30
Phosphorus, %	0.43	0.43	0.43	0.43	0.43
Lysine, %	1.29	1.29	1.29	1.29	1.29
Methionine, %	0.52	0.51	0.51	0.51	0.51
M.E (kcal/kg)	2897.34	2896.18	2894.31	2893.46	2891.80

*Vitamin mineral premix per kg of diet: Fe 100 mg, Mn 110 mg, Cu 20 mg, Zn 100 mg, I 2 mg, Se 0·2 mg, Co 0·6 mg, sanoquin 0·6 mg, retinal 2000 mg, cholecalciferol 25 mg, α-tocopherol 23000 mg, menadione 1·33 mg, cobalamin 0·03 mg, thiamin 0·83 mg, riboflavin 2 mg, folic acid 0·33 mg, biotin 0·03 mg, pantothenic acid 3·75 mg, niacin 23·3 mg and pyridoxine 1·33 mg.

[1] NC- Negative control (0kg Diamond V^{xpc}/tone), PC- Positive control (0.35kg Diamond V^{xpc}/tone and 0.35kg Enerzyme/tone), T1- Treatment 1 (1.25kg Diamond V^{xpc}/tone), T2- Treatment 2 (1.5kg Diamond V^{xpc}/tone), T3-Treatment 3 (2.0kg Diamond V^{xpc}/tone) of feed.

ME: Metabolizable energy

Table6.3. *Percentage composition of the experimental diets at finisher phase*

Ingredients (kgs)	**FINISHER PHASE TREATMENTS[1]**				
	NC	**PC**	**T1**	**T2**	**T3**
Maize	510.15	510	509.1	509	508.5
Fishmeal	40	40	40	40	40
Soybean meal	150	150	150	150	150
BSM	200	200	200	200	200
Wheat bran	50.6	50.6	50.6	50.6	50.6
Oyster shell	18.5	18.5	18.5	18.5	18.5
Bone meal	20	20	20	20	20
Salt	3	3	3	3	3
Vit. trace mineral premix	3	3	3	3	3

Lysine	2.60	2.6	2.6	2.6	2.6
Methionine	1.80	1.6	1.8	1.8	1.8
Enerzyme-select	0.35	0.35	-	-	-
Diamond V	-	0.35	1.25	1.5	2.0
TOTAL	1000.0	1000.0	1000.0	1000.0	1000.0
Nutrient composition (calculated)					
Crude protein, %	19.2	19.2	19.2	19.2	19.2
Ether Extract, %	3.9	3.9	3.9	3.9	3.9
Crude fibre, %	2.7	2.7	2.7	2.7	2.7
Calcium, %	1.6	1.6	1.6	1.6	1.6
Phosphorus, %	0.6	0.6	0.6	0.6	0.6
Lysine, %	1.2	1.2	1.2	1.2	1.2
Methionine, %	0.5	0.5	0.5	0.5	0.5
Metabolisable energy(kcal/kg)	2908.5	2907.3	2905.5	2904.9	2903.2

*vitamin mineral premix/kg diet: Fe 100mg, Mn 110mg, Cu 20mg, Zn 100mg, I 2mg, Se 0.2mg, Co 0.6mg, Sanoquin 0.6mg, retinal 2000mg, cholecalciferol 25mg, α-tocopherol 2300mg, menadione 1.33mg, cobalamin 0.03mg, thiamin 0.83mg, riboflavin 2mg, folic acid 0.33mg, biotin 0.03mg, pantothenic acid 3.75mg, niacin 23.3mg and pyridoxine 1.33mg

[1] NC- Negative control (0kg Diamond V^{xpc}/tone), PC- Positive control (0.35kg Diamond V^{xpc}/tone and 0.35kg Enerzyme/tone), T1- Treatment 1 (1.25kg Diamond V^{xpc}/tone), T2- Treatment 2 (1.5kg Diamond V^{xpc}/tone), T3-Treatment 3 (2.0kg Diamond V^{xpc}/tone) of feed.

ME: Metabolizable energy

Growth and Carcass Parameters

Data on parameters required for the assessment of growth performance of the birds were taken on weekly basis from week one to the eighth week. The parameters measured included; feed intake, body weight and body weight gain, feed conversion ratio (FCR) and economics of production.

Feed consumption of birds was measured weekly. Feed consumed per birds per pen was measured by subtracting feed left over in trough from total feed supplied for a week using a digital electronic scale (Jadever, JPS-1050). It was then divided by the number of birds in a replicate and number of days to obtain mean feed intake per bird per day.

Live weight and live weight gain were measured by weighing the birds in each pen at the beginning of the trial and subsequently at the end of every week. Birds were batch weighed and the weight divided by the number of birds in each batch to obtain the mean live weight per bird. The initial average live weight per bird was subtracted from the weekly average live weight to obtain the live weight gain per week.

Feed Conversion Ratio (FCR) was calculated as feed/gain ratio. Mean weekly feed conversion was calculated by dividing the feed consumed by the live weight gain during the same period.

Carcass evaluation was carried out at the end of the trial. Four birds per replicate were randomly selected, fasted overnight and slaughtered by severing the jugular vein. Bled weight, defeathered weight and dressed weight of the birds were taken. The internal organs such as heart, kidney, gizzard, kidney, liver, were all weighed separately and recorded using electric micrometer 3000g weighing gauge as described by Jahanian *et al.* (2008).

Storage and Origin of DFM (Diamond V^{xpc})

The direct fed microbial (Diamond ^{Vxpc}) used in the experiment was a single strain product produced by the Diamond V company, a leading global animal health company in the USA. It appears to be tan to brown granular powder with a fermented, yeasty aroma. Diamond V^{XPC} is a probiotic with *Saccharomyces cerevisiae* as its main constituent and media on which it was grown, consisting of roughage products, processed grain by-products and cane molasses. It was stored in a cool dry environment.

Statistical Analysis

Growth performance and carcass data were subjected to the GLM procdure of Statistical Analytical System, SAS (2014) at 5% level of probability to assess significant differences. Treatment means were separated using Waller Duncan's K-ratio t-test in SAS.

Results and Discussion

Growth Performance

Feed intake did not differ significantly (P>0.05) among birds which fed on Diamond V^{xpc} dietary treatements (T1, T2 and T3). However, PC and NC were numerically higher than the other Diamond V^{xpc} treated diets (Table 6.4). Feed intake for birds on the negative control (NC) recorded about 19% more than the feed intake for birds on T2 and T3.

This finding is in concord with the research by Kabir *et al*. (2004) and that of Habibi *et al*. (2013) when probiotics were fed to broiler chickens. Arslan and Saatci (2002) also observed an increase in feed intake for the control group as compared to quails on the DFM diets. The lower feed consumption recorded for all the probiotic treated birds (PC, T1, T2 and T3) could be attributed to the fact that the probiotics provided a well-balanced microbial ecosystem in the GIT. A well-balanced microbial ecosystem means microorganism present in probiotics possibly secreted amylase, protease, and lipase (Rolfe, 2000) that accelerate nutrient digestibility (Apata, 2008 and Li *et al.,* 2008). In these circumstances birds do not have to consume much for growth and body weight and that could explain for the low feed intake recorded for birds on the probiotic diets. Moreover, bacteria like *Clostridium perfringens* causes damage to the intestinal mucosa and this decreases digestion and absorption and increases feed conversion ratio (Kaldhusdal *et al.,* 2001 and Hofacre *et al.,* 2003). When there is a balance microbial ecosystem, the effect of these pathogens is surmounted and thereby increasing the rate of digestion and absorption as feed conversion ratio decreases.

The performance results at the end of the experimental period showed insignificant differences in the final body weights (P=0.48) and the feed conversion ratio (P=0.09). Al-Sagan and Abudabos (2017) also reported a non-statistical difference for body weight and feed conversion ratio when the effect of a prebiotic, probiotic and symbiotic on performance of broilers under *Clostridium perfringens* challenge were studied. Kwakernaak *et al*. (2007) reported that *B. subtilis* spores supplementation in a wheat-SB based diet did not significantly affect the overall body weight gain and feed conversion ratio at 36 days. The findings of this study again confirms those reported by Mountzouris *et al*. (2007), when cumulative FCR of probiotic birds did not significantly differ from that of the antibiotic treatment. It was however observed that all the DFM supplemented diets had a better FCR with the exception of the positive control.

Carcass Parameters

Generally, the treatments had no significant difference (P> 0.05) on the internal organs weighed, except the full intestine weight which was significant (P < 0.05) (Table 6.5). Ozcan Cengiz *et al.* (2015) experimented the effect of dietary probiotic and high stocking density on the performance, carcass yield, gut microflora, and stress

indicators of broilers and no treatment effects on the overall relative carcass yield and weights of lymphoid organs were observed. Other researchers (Pelicano *et al.*, 2003, 2005; Karaoglu and Durdag, 2005) also reported no dietary treatment effects on carcass yield of broilers when probiotics were fed.

Table6.4. *Effect of Diamond VXPC on growth performance of broiler chickens*

Parameters	Treatments[1]					SEM	P-value
	PC	NC	T1	T2	T3		
Initial weight/bird/g	39.12	38.80	39.15	38.95	39.38	2.72	0.60
Final weight/bird/g	3115.00	3538.00	3125.00	2950.00	3212.00	680.90	0.48
Total weight gain/bird/g	3076.00	3500.00	3086.00	2915.00	3173.00	679.80	0.48
Daily weight gain/bird/g	54.93	62.50	55.10	52.05	56.66	12.14	0.48
Total feed intake/bird/g	8408.79	9087.73	7465.19	7355.82	7387.48	1332.5	0.05
Daily feed intake/bird/g	150.16	162.28	133.31	131.35	131.92	23.80	0.05
FCR	2.74	2.61	2.44	2.53	2.35	0.28	0.09
Feed cost/kg@ starter phase	1.77	1.79	1.85	1.87	1.90	-	-
Feed cost/kg@ finisher phase	1.72	1.74	1.80	1.82	1.85	-	-
Feed cost/gain @ starter phase	4.85	4.68	4.52	4.73	4.47	0.53	0.56
Feed cost/gain @ finisher phase	4.72	4.55	4.40	4.61	4.36	0.51	0.57

[1] NC- Negative control (0kg Diamond V^{xpc}/tone), PC- Positive control (0.35kg Diamond V^{xpc}/tone and 0.35kg Enerzyme/tone), T1- Treatment 1 (1.25kg Diamond V^{xpc}/tone), T2- Treatment 2 (1.5kg Diamond V^{xpc}/tone), T3-Treatment 3 (2.0kg Diamond V^{xpc}/tone) of feed.

SEM: standard error of means, P-value: Probability value

Table6.5. *Effect of Diamond VXPC on carcass traits of broiler chickens*

Parameters	Treatments[1]					SEM	P-value
	PC	NC	T1	T2	T3		
Bled weight/bird	2880	3360	3040	2850	3090	0.75	0.61
Defeathered weight/bird	2710	3210	2880	2740	2920	0.71	0.59
Dressed weight/bird	2325	2812	2525	2300	2538	0.61	0.42
Viscera weight/bird	33.8	32.5	36.2	27.5	30.0	0.09	0.32
Head weight/bird	66.3	63.5	60.2	61.5	58.5	0.01	0.75
Heart weight/bird	13.3	14.0	12.0	11.5	14.8	0.01	0.60
Liver weight/bird	60.7	59.7	63.0	60.5	54.2	0.01	0.52
Full Gizzard weight/bird	73.5	87.0	84.5	73.5	83.7	0.02	0.35
Empty Gizzard weight/bird	45.0	56.0	58.7	46.5	59.0	0.02	0.23
Full intestine weight/bird	136.5	137.8	172.5	112.3	120.5	0.03	0.01
Empty intestine weight/bird	72.20	72.20	68.30	56.50	68.80	0.02	0.43

[1] NC- Negative control (0kg Diamond V^{xpc}/tone), PC- Positive control (0.35kg Diamond V^{xpc}/tone and 0.35kg Enerzyme/tone), T1- Treatment 1 (1.25kg Diamond V^{xpc}/tone), T2- Treatment 2 (1.5kg Diamond V^{xpc}/tone), T3-Treatment 3 (2.0kg Diamond V^{xpc}/tone) of feed.

SEM: standard error of means, P-value: Probability value

Economics of Production

From Table 6.4, feed cost per kilogram at the starter and finisher phases increased when the Diamond V^{XPC} was added from NC (no Diamond V^{XPC}) to T3 (2.0% Diamond V^{XPC}). The higher price in the Diamond V^{XPC} diets is the additional cost from the Diamond V^{XPC}. However, a different trend was observed at feed cost per gain where T3 (2.0% Diamond V^{XPC}) which recorded the highest feed cost per kg now has the lowest feed cost/gain (Table 6.4) at both the starter and the finisher phases. This could be attributed to the fact that birds on the T3 were more efficient and utilized less feed to gain more weight; hence the lesser cost on the feed cost/gain (Table 6.4) compared to the controls (i.e. PC and NC). The farmer stands the chance of making additional 7.84% and 7.63% profit of using Diamond V^{XPC} at 2% than not using it as in the case of NC at starter and finisher phases respectively.

Conclusion and Recommendation

The study revealed that adding Diamond V^{XPC} at 2% to the feed of broiler birds resulted in an efficient growth performance and a better feed cost/weight gain. The study also showed that, adding Diamond V^{XPC} at 1.25 to 2% to the feed reduced feed intake and gave an improved feed efficiency. It can be deduced that it is more economical and efficient to raise broiler chickens on treatment 3 (T3) than any of the treatments in the study. It is recommended that producers and farmers can add Diamond V^{XPC} to the diets of their birds up to 2% inclusion without any detrimental effect on the birds.

References

Alkhalf, A., Alhaj, M. and Al-Homidan, I., 2010. Influence of probiotic supplementation on blood parameters and growth performance in broiler chickens. Saudi journal of biological sciences, 17(3), pp.219-225.

Al-Sagan, A.A. and Abudabos, A.M., 2017. Effect of a prebiotic, probiotic and symbiotic on performance of broilers under Clostridium Perfringens challenge. The Thai Journal of Veterinary Medicine, 47(2), pp.257-264.

AOAC, 1995. Official Methods of Analysis of AOAC International, Association of Official Analytical Chemists, Washington, DC, USA

AOAC, 2002. Official Methods of Analysis of AOAC International. Association of Official Analytical Chemists, Washington, DC, USA

Aning, K.G., 2006. The structure and importance of the commercial and village based poultry in Ghana. Poultry Review Report prepared for FAO.

Apata, D.F., 2008. Growth performance, nutrient digestibility and immune response of broiler chicks fed diets supplemented with a culture of Lactobacillus bulgaricus. Journal of the Science of Food and Agriculture, 88(7), pp.1253-1258.

Arslan, C. and Saatci, M., 2004. Effects of probiotic administration either as feed additive or by drinking water on performance and blood parameters of Japanese quail. *Archiv fur Geflugelkunde*, *68*(4), pp.160-163.

Bawah, J., 2015. Effects of commercial Probiotic preparations on the growth, Egg laying, Haematological and Immunological traits of Chickens (Doctoral dissertation).

Benson, H.J., 2002. Microbiological applications 8th edition. New York, 3, p.926.

Canadian Council on Animal Care, 2009. CCAC guidelines on: The care and use of farm animals in research, teaching and testing. Can. Counc. Anim. Care.

Dibner, J.J. and Richards, J.D., 2005. Antibiotic growth promoters in agriculture: history and mode of action. Poultry science, 84(4), pp.634-643.

FAO., 2009. Food and Agriculture Organization of the United Nations. Guidelines for the evaluation of probiotics in food. Available at: ftp://ftp.fao.org/es/esn/food/ wgreport2.pdf (accessed January 27, 2009).

Habibi, S., Khojasteh, S. and Jafari, M., 2013. The effect of Bactocell and Protexin probiotics on performance and carcass characteristics of broiler chickens. J. Nov. App. Sci, 11, pp.565-570.

Hofacre, C.L., Froyman, R., Gautrias, B., George, B., Goodwin, M.A. and Brown, J., 1998. Use of Aviguard and other intestinal bioproducts in experimental Clostridium perfringens-associated necrotizing enteritis in broiler chickens. Avian Diseases, pp.579-584.

Jahanian, R., Moghaddam, H.N. and Rezaei, A., 2008. Improved broiler chick performance by dietary supplementation of organic zinc sources. Asian-Aust. J. Anim. Sci, 21(9), pp.1348-1354.

Kabir, S.M.L., Rahman, M.M., Rahman, M.B., Rahman, M.M. and Ahmed, S.U., 2004. The dynamics of probiotics on growth performance and immune response in broilers. Int. J. Poult. Sci, 3(5), pp.361-364.

Kaldhusdal, M., Schneitz, C., Hofshagen, M. and Skjerve, E., 2001. Reduced incidence of Clostridium perfringens-associated lesions and improved performance in broiler chickens treated with normal intestinal bacteria from adult fowl. Avian Diseases, pp.149-156.

Karaoglu, M. and Durdag, H., 2005. The influence of dietary probiotic (Saccharomyces cerevisiae) supplementation and different slaughter age on the performance, slaughter and carcass properties of broilers. International Journal of Poultry Science, 4(5), pp.309-316.

Kim, S.H., Yu, D.J., Lee, S.J., Park, S.Y., Ryu, K.S. and Lee, D.G., 2003. Effects of Feeding Aspergillus oryzae Ferments on Performance, Intestinal Microfloua, Blood Serum Components and Environmental Factors in Broiler. Korean Journal of Poultry Science.

Koney E. B. M., 1993. Poultry Health and Production. 33pp. Lawes Agriculture Trust. Kwakernaak, C., Van Der Klis, J.D. and De Gussem, K., 2007, August. The effect of a pre-and probiotic on the performance of broilers. In World Poultry Science Association, Proceeding of the 16th European Symposium on Poultry Nutrition (pp. 565-568).

GenStat 8th ed. Rothamsted Experimental Station, Harpenden, UK.

Laboratory Info., 2015. Indole Test: principle, procedure and Interpretation

Li, L.L., Hou, Z.P., Li, T.J., Wu, G.Y., Huang, R.L., Tang, Z.R., Yang, C.B., Gong, J., Yu, H., Kong, X.F. and Pan, E., 2008. Effects of dietary probiotic supplementation on ileal digestibility of nutrients and growth performance in 1-to 42-day-old broilers. Journal of the Science of Food and Agriculture, 88(1), pp.35-42.

Mountzouris, K.C., Tsirtsikos, P., Kalamara, E., Nitsch, S., Schatzmayr, G. and Fegeros, K., 2007. Evaluation of the efficacy of a probiotic containing Lactobacillus, Bifidobacterium, Enterococcus, and Pediococcus strains in promoting broiler performance and modulating cecal microflora composition and metabolic activities. Poultry science, 86(2), pp.309-317.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academic Press, Washington, DC.

Obi, O.O. and Sonaiya, E.B., 1995. Gross margin analysis of small holder rural poultry production in Osun state. Nigerian Journal of Animal Production, 22, pp.95-107.

Olatoye, I.O., Okocha, R.C. and Olumide, P.M., 2014. Effects of commercial yeast probiotic (Antox R Supplement) on broiler chickens growth performance and Salmonella inhibition. J. Agric. Vet. Sci, 7, pp.46-50.

Cengiz, Ö., Köksal, B.H., Tatlı, O., Sevim, Ö., Ahsan, U., Üner, A.G., Ulutaş, P.A., Beyaz, D., Büyükyörük, S., Yakan, A. and Önol, A.G., 2015. Effect of dietary probiotic and high stocking density on the performance, carcass yield, gut microflora, and stress indicators of broilers. Poultry science, 94(10), pp.2395-2403.

Patterson, J.A. and Burkholder, K.M., 2003. Application of prebiotics and probiotics in poultry production. Poultry science, 82(4), pp.627-631.

Pelicano, E.R.L., Souza, P.A., Souza, H.B.A., Oba, A., Boiago, M.M., Zeola, N.M.B.L., Scatolini, A.M., Bertanha, V.A. and Lima, T.M.A., 2005. Carcass and cut yields and meat qualitative traits of broilers fed diets containing probiotics and prebiotics. Revista Brasileira de Ciência Avícola, 7(3), pp.169-175.

Pelicano, E.R.L., De Souza, P.A., De Souza, H.B.A., Oba, A., Norkus, E.A., Kodawara, L.M. and De Lima, T.M.A., 2003. Effect of different probiotics on broiler carcass and meat quality. Revista Brasileira de Ciência Avícola, 5(3), pp.207-214.

Rolfe, R.D., 2000. The role of probiotic cultures in the control of gastrointestinal health. The Journal of nutrition, 130(2), pp.396S-402S.

Salarmoini, M. and Fooladi, M.H., 2010. Efficacy of Lactobacillus acidophilus as probiotic to improve broiler chicks performance. Journal of Agricultural Science and Technology, 13, pp.165-172.

SAS Institute Inc., 2014. SAS/STAT® 9.3 Procedures Guide. Cary, NC: SAS Institute Inc. Simon, O., Vahjen, W. and Scharek, L., 2005. Micro-organisms as feed additives-probiotics. Advances in pork Production, 16, pp.161-167.

Sarfo, G.K., Larbi, A., Hamidu, J.A. and Donkoh, A., 2018. Effect of direct-fed microbial addition in guinea fowl (*Numida meleagris*) diets on performance and health responses. Poultry science, 97(6), pp.1909-1913.

Wolfenden, A.D., Vicente, J.L., Higgins, J.P., Andreatti Filho, R.L., Higgins, S.E., Hargis, B.M. and Tellez, G., 2007. Effect of organic acids and probiotics on Salmonella enteritidis infection in broiler chickens. Int. J. Poult. Sci, 6, pp.403-405.

Yang, Y., Iji, P.A. and Choct, M., 2009. Dietary modulation of gut microflora in broiler chickens: a review of the role of six kinds of alternatives to in-feed antibiotics. World's Poultry Science Journal, 65(1), pp.97-114.

Zulkifli, I., Abdullah, N., Azrin, N.M. and Ho, Y.W., 2000. Growth performance and immune response of two commercial broiler strains fed diets containing Lactobacillus cultures and oxytetracycline under heat stress conditions. British poultry science, 41(5), pp.593-597.

Citation: **G. K. Sarfo, A. Donkoh, J. A. Hamidu,** "*Effect of Diamond V^{xpc} (Direct Fed Microbial) on Broiler Performance and Health Status*". *American Research Journal of Agriculture, V4, I1; pp:1-10.*