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National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:japr@napri.gov.ng Url:journal.napri.gov.ng

EFFECT OF PROBIOTIC (*LACTOBACILLUS ACIDOPHILUS*) ON GROWTH, STRESS AND SERUM LIPID PROFILE OF FINISHER BROILER CHICKENS IN THE HOT SEASON

***[1]Obamedo, T. N., [1]Duru, S., [1]Omage, J., [1]Olugbemi, T. S. and [2]Olutunmogun, A. K.**
[1]Department of Animal Science, Ahmadu Bello University, Zaria
[2]National Animal Production Research Institute, Ahmadu Bello University, Zaria
**Corresponding email*: titinekpen4sucess@gmail.com

ABSTRACT

This experiment was conducted with the objective of determining the effect of *Lactobacillus acidophilus* strain of probiotic on growth, stress markers and serum lipid profile of finisher broiler chicken in the hot season. Two hundred and four (204) NAPRI-X broilers age four weeks were used in this study. The birds were assigned to four dietary treatments which consist of: a control diet, *Lactobacillus acidophilus* 200g (*L.* 200g), *Lactobacillus acidophilus* 300g (*L.* 300g) and oxytetracycline 60g in a complete randomized design experiment (CRD). The results show that all growth parameters measured on the test materials had significant ($p<0.05$) differences with the *L.* 300g inclusion level being better than the others. Lipid profile parameters considered were significant ($p<0.05$) with the exception of low density lipo-protein. Oxidative stress markers showed that all the parameters had significant ($p<0.05$) differences with *L.* 300g and oxytetracycline having similar effects except for super oxide dismutase (SOD) marker. Therefore it can be concluded that inclusion of probiotics (*Lactobacillus acidophilus*) at *L.* 300g performed favourably well in some of the growth performance parameters, lipid profile and oxidative stress marker as against the control and oxytetracycline groups during hot season. Therefore it is recommended that *L.* 300g be included into the diets of broiler chickens as replacement for antibiotics during the hot dry season.

Keywords: Broiler chicken, Growth, Probiotics, Hot season, Stress

INTRODUCTION

Genetic selection had improved the growth rate of birds and profit to farmers however; it has increased sensitivity of these birds to stressors. Stress produces severe internal damages leading to a negative impact on economic traits. Broilers are subjected to frequent stress factors and therefore, it is important to have an effective management programme to minimize their effects on performance and health of the birds (Habibian *et al*., 2013). Even under the best nutritional conditions, environmental stress under commercial production conditions can increase intestinal bacteria proliferation and make broilers prone to enteric problems (Oviedo-Rondon *et al*., 2010). Antibiotics are used worldwide with the goal of enhancing growth performance and preventing illnesses. Over the years, the use of antibiotics in poultry diets has resulted in undesirable outcomes such as the resistance of microorganisms to antibiotics, accumulation of antibiotic residues in animal products and the environment (Sino *et al*., 2012). This has necessitated restrictions or total ban on the use of antibiotics in animal and poultry production in several countries. Therefore, the poultry industry must develop alternatives to antibiotics to maintain health and performance under commercial conditions. Probiotics have been increasingly adopted as

alternatives to antibiotic growth promoters in poultry diets (Mountzouris *et al*., 2010; Zhang and Kim 2014). The addition of pure lactobacillus cultures and other bacteria to broiler diets has produced variable results. Probiotics display numerous health benefits beyond providing basic nutritional advantages (Quinteiro-Filho *et al*., 2010). Probiotic products consisting of beneficial micro-flora can help establish and maintain the balance of the intestinal micro-flora in commercial broilers. A consistent improvement in body weight gain of chickens fed a culture of lactobacillus has also been reported (Awad *et al*., 2009). Nutritional manipulations are easy and effective means to reduce stress. Now, probiotics are widely used in commercial broiler production to reduce stress. Hence this study was carried out to access the effect of probiotic supplementation to finisher broilers in alleviating stress and improving production during the hot season in Northern Guinea Savannah of Nigeria.

MATERIALS AND METHODS

Experimental Site

This experiment was conducted at the Research Unit of the Poultry Research Programme National Animal Production Research Institute (NAPRI), Shika-Zaria. Shika lies between latitude 11º 12' 42" N and longitude 7º 33' 14" E and at an altitude of 640m above sea level (Ovimaps, 2017). The temperature of Shika ranges between 14.5 – 39.5ºC with humidity range of 21 – 72%. The climate is characterized by well-defined dry and wet seasons which are divided into cold-dry season (November - February), hot-dry season (March - May) and wet season (June - October) as described by Kabir *et al*. (2006).

Experimental Material

The experimental material used for this study was the *Lactobacillus acidophilus* probiotic strain (*LACTO Acidophilus*) manufactured by **MIAVIT®** in Germany.

Management of Experimental Animals

Two hundred and four (204) NAPRI-X finisher broilers aged 28days old (4weeks) were used in a completely randomized design (CRD) experiment. The birds were randomly divided into four groups and the groups randomly assigned to 4 treatments with 51 birds per treatment. Each treatment had three (3) replicates of 17 birds each. Treatment 1 served as the control, treatments 2 and 3 had *L acidophilus* included at 200 and 300g per 100kg diet respectively while treatment 4 had Oxytetracycline at 60g per 100kg diet (manufacturer's recommendation). The birds were housed in an independent open-sided house measuring 3mx4m. Feed and water were provided *ad-libitum* throughout the experimental period while necessary vaccination was duly administered. The proximate compositions of the experimental diets are as shown in the Table 1 below:

Table 1: Proximate composition of formulated broiler finisher diet

Components	Control	*L.* 200g	*L.* 300g	Oxyte.
Dry matter	92.32	92.32	92.32	92.32
Crude protein (%)	23.67	23.67	23.67	23.67
Crude fibre (%)	4.80	4.80	4.80	4.80
Ether Extract	3.41	3.41	3.41	3.41
Ash (%)	5.73	5.73	5.73	5.73
NFE (%)	62.39	62.39	62.39	62.39
Energy (Kcal/Kg)	2937	2937	2937	2937

L. = *Lactobacillus acidophilus*, Oxyte. = Oxytetracycline

Data collection and Statistical Analysis

Data was collected on growth performance (initial and final body weights, total weight gain and total feed consumed, feed conversion ratio feed cost/weight gain), lipid profile (total cholesterol, triglyceride, high and low density lipoprotein and triglyceride: high density lipoprotein) and oxidative stress marker (Malondialadhyde, Catalase, Super-oxide dismutase, and Reduced glutathione). Blood sample were collected from the birds at the end of the experiment and used to determine lipid profile and oxidative parameters. The data obtained were subjected to a one-way ANOVA test of the SAS, (2002) version package while significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

The result of growth performance of broiler finisher chickens fed *Lactobacillus acidophilus* based diet in hot-dry season is shown in Table 2. Significant ($p<0.05$) differences were observed in all the parameters with the exception of feed cost which was not analyzed. This result is in agreement with the report of Karthiayini and Philomina, (2014) on growth performances parameters who stated that probiotics supplementation improved the production parameters of stressed broilers under high temperature (32.68°C) and humidity (88.25%) during the summer season. However the observed results disagreed with the findings of Attia *et al*. (2011), Imik *et al*. (2012), Quinteiro-Filho *et al*. (2012) and Habibian *et al*. (2013) who reported a significant reduction in body weight and feed intake in chronic heat stressed broilers. These authors also reported increased feed conversion ratio. Probiotics is known for the improvement in growth parameters of body weight gain, feed intake, final body weight and feed conversion ratio (Qaisrani *et al*., 2015). It has also been reported that probiotics bacteria synthesize certain amino acids and produce B-vitamins such as folic acid, niacin, riboflavin, B_6, B_{12} and pantothenic acid, which are biocatalyst in food metabolism, directly assimilation and help to fight stress (Klopp-Holliman, 2001 and Qaisrani *et al*., 2015).

Table 2: Growth performance of broiler finisher chickens fed probiotics based diet in hot-dry season

		L. acidophilus			
Parameters	**Control**	**200g**	**300g**	**Oxytet.**	**SEM**
Initial Weight (g/bird)	534.37^{b}	537.50^{ab}	547.36^{a}	536.45^{ab}	5.98*
Final Weight (g/bird)	1727.08^{ab}	1672.92^{b}	1814.03^{a}	1745.42^{ab}	63.65*
Total weight gain	1192.71^{ab}	1135.42^{b}	1266.67^{a}	1208.96^{ab}	61.61*
Total Feed Consumed (g/bird)	2005.51^{b}	2088.26^{b}	2100.28^{b}	2254.65^{a}	48.45*
Feed Conversion Ratio	1.68^{a}	1.84^{b}	1.65^{a}	1.87^{b}	0.07*
Feed cost (₦/Kg)	121.80	127.40	130.20	127.80	-
Feed cost/gain (₦/Kg gain)	145.27^{b}	144.65^{b}	164.92^{a}	154.51^{ab}	7.85*

^{ab}= Means with different superscript on the same row are significantly different ($p<0.05$), SEM= Standard Error of Mean, Oxytet = Oxytetracycline, *=significant difference

Table 3 shows the effect of probiotics (*L. acidophilus*) levels on lipid profile of broilers. There were significant ($p<0.05$) difference in total cholesterol, triglyceride, high density lipoprotein and triglyceride. Low density lipoprotein showed a non-significant ($p>0.05$) difference across treatments. The serum cholesterol was highest in birds fed probiotics (200g and 300g) and antibiotic inclusion groups (91.00 mg/dL, 86.92 mg/dL and 86.66 mg/dL respectively) when compared to the control group. The result contradicted the reports of Uzochukwu *et al*. (2015) and Navid, (2010) that the supplementation of probiotics in the nutrition of broiler reduced their serum cholesterol levels. The observed increase in total cholesterol in this study can be attributed to disturbances during lipogenesis which occurs as a result of up-regulation of hepatic lipogenic enzymes through an increase in mRNA gene expression level of these enzymes as reported by Pei *et al*. (2009)**.** This metabolic disorder has been associated with lipid peroxidation and oxidative stress (Matsuzawa *et al*., 2007). Also, the increase of total cholesterol level been attributed to the heat stress and season induced hyper-lipidemia which was associated with constant increases in total cholesterol blood levels and some other lipid components **(**Ramin *et al*., 2012). There was a significant increase in serum HDL levels of probiotics inclusion groups which agreed with the report of Chi *et al*. (2003) who observed similar increase in HDL.

Table 3: Effect of probiotic levels on lipid profile of broiler finisher chickens in hot-dry season

Parameters	Control	*L. acidophilus* 200g	*L. acidophilus* 300g	Oxytet.	SEM
Total Cholesterol (mg/dL)	76.00[b]	91.00[a]	86.92[a]	86.66[a]	3.37*
Triglyceride (mg/dL)	78.67[a]	21.45[b]	19.81[b]	19.56[b]	20.40*
HDL (mg/dL)	33.26[c]	44.62[a]	36.74[bc]	42.95[ab]	3.32*
LDL (mg/dL)	23.03	24.93	30.37	29.15	4.46
TRYGL:HDL (mg/dL)	2.38[a]	0.48[b]	0.53[b]	0.46[b]	0.6*

[abc]= means with different superscript on the same row are significantly different (P<0.05), HDL., = High Density Lipoprotein, LDL = Low Density Lipoprotein, SEM= Standard Error of Mean, Oxytet = Oxytetracycline, *=significant difference

Table 4 shows the effect of probiotics (*L. acidophilus*) levels on oxidative stress markers. The result showed that there were significant ($p<0.05$) differences in malondialdehyde, catalase and reduced glutathione (GSH) among treatments whereas there was no significant ($p>0.05$) difference in superoxide dismutase. The higher values recorded for 300 *L. acidophilus* dietary groups could be due to in-balance between concentrations of reactive oxygen species (ROS). The results were in agreement with those of Enkhtaivan *et al*. (2011) who revealed that hyperlipidemia caused a significant increase of serum MDA. Similarly reports have shown that there was a positive linkage in the correlation of serum total cholesterol level and Malonddialadhyde (MDA) profile (Doaa *et al*., 2014). Exposure to heat stress increased lipid peroxidation as a consequence of the increased generation of reactive oxides (ROS) which was indicated by the concentration of MDA (Lin *et al*., 2010). Therefore, the content of MDA in serum and tissue could reflect the extent of lipid peroxidation and over production of ROS in the body. Fernanda *et al*. (1995) observed that the imbalance in the antioxidant defense system seems to be as a result of the accumulation of Low density lipo protein (LDL) in the course of hyperlipidemia. Exposure to heat stress increased lipid peroxidation which was indicated by the increase in MDA concentration (Lin *et al*., 2010). These results were similar to findings of Song *et al*. (2000) who demonstrated that mobilization of the reduced GSH storage pool increased when broiler chickens were subjected to heat stress. GSH and Super-oxide dismutase (SOD) prevent cells from the free radical-induced damage and provide a repair mechanism for oxidized membrane components. The activity of SOD was inversely correlated with total cholesterol levels (Fernanda *et al*., 1995).

Table 4: Effect of probiotic levels on oxidative stress of broiler finisher chickens in hot-dry season

		L. acidophilus			
Parameters	**Control**	**200g**	**300g**	**Oxytet**	**SEM**
MDA (mg/dL)	11.46^{b}	12.00^{b}	14.66^{a}	14.40^{a}	0.38*
CAT (mg/dL)	49.70^{a}	40.30^{b}	49.53^{a}	49.00^{ab}	3.54*
SOD (mg/dL)	19.63	18.97	19.00	17.63	1.09
GSH (mg/dL)	24.66^{c}	24.56^{c}	35.43^{b}	41.76^{a}	1.48*

^{abc}= means with different superscript on the same row are significantly different (P<0.05), MDA = Malondialadhyde, CAT = Catalase, SOD = Super-oxide dismutase, GSH = Reduced glutathione, SEM= Standard Error of Mean, Oxytet = Oxytetracycline, *=significant difference

CONCLUSION

The inclusion of probiotics (*Lactobacillus acidophilus*) at 300g competed favourably well in some of the growth performance parameters (feed consumption and feed conversion ratio) compared to the antibiotics (oxytetracyline) groups, the lipid profile and oxidative stress markers were also influenced by 300g *Lactobacillus acidophilus* supplemented groups during the hot season. Therefore, *Lactobacillus acidophilus* at 300g could be used as replacement for antibiotics (oxytetracycline) which had been ban due to its residual effect on human health.

REFERENCES

Attia, Y. A., Hassan, R. A., Tag-El-Din, A. E. and Abou-Shehema, B. M. (2011). Effect of ascorbic acid or increasing metabolizable energy level with or without supplementation of some essential amino acids on productive and physiological traits of slow-growing chicks exposed to chronic heat stress. *Animal Physiology Animal Nutrition*, 95: 744–755.

Awad, W. A., Ghareeb, K., Abdel-Raheem, S. and Bohm, J. (2009). Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights and intestinal histo-morphology of broiler chickens. *Poultry Science*, 88: 49-56.

Chi, S. C., Jing, H. W., Tung, L. T. and Chao, H. H. (2003). Correlation between fatty liver and lipidemia in Taiwanese. *Journal of Medicine and Ultrasound*, 11: 60–65.

Doaa, S. M., Magdy, F. E., Kamel, M. A. H. and Khalid, S. H. (2014). The ameliorative effects of L-carnitine and symbiotic on induced hyperlipidemia and oxidative stress in broilers. *International Journal of Advanced Research*, 2(8): 378-390.

Duncan, D. B. (1955). Multiple range and multiple F-tests. *Biometric*, 11: 1-42.

Enkhtaivan, O., Malchinkhuu, M. and Tserenkhuu, L. (2011). Oxidative stress and antioxidant parameters in patients with hyperlipidemia. *Atherosclerosis Supplements*, 12: 13–184.

Fernanda, B. A., Dccio, S.B., Chang, Y. H., Raul, C. M. and Dulcineia, S. P. A. (1995).

Evaluation of oxidative stress in patients with hyperlipidemia. *Atherosclerosis*, 17: 61-71.

Habibian, M., Ghazi, S., Moeini, S. and Abdol-Mohammadi, A. (2013). Effects of dietary selenium and vitamin E on immune response and biological blood parameters of broilers reared under thermo neutral or heat stress conditions. *International Journal of Biometeorology*, 10: 1007.

Imik, H., Ozlu, H., Gumus, R., Atasever, M. A., Urgar, S. and Atasever, M. (2012). Effects of ascorbic acid and alpha-lipoic acid on performance and meat quality of broilers subjected to heat stress. *British Journal of Poultry Science,* 53: 800 - 808.

Kabir, M., Oni, O. O., Akpa, G. N. and Adeyinka, I. A. (2006). Heritability estimates and inter-relationships of body weights and shank lengths in Rhode Island Red and White chickens. *Pakistan Journal of Biological Science*, 9(15): 2892 – 2896.

Karthiayini, K. and Philomina, P.T. (2014). Probiotic supplementation in alleviating stress in broiler chicken. *Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 7(9): 54-58.

Klopp-Holliman, L. (2001). Prophylactic and therapeutic uses of probiotics: A review. *Journal of American Dietetic Association,* 10(2): 1229 -1238.

Lin, Y., Gao, Y. T., Yu, Q. F., Jin, H. F. and Min, H. Z. (2010). Effects of acute heat stress and subsequent stress removal on function of hepatic mitochondrial respiration, ROS production and lipid peroxidation in broiler chickens. *Comparative Biochemistry and Physiology*, Part C. 151: 204–208.

Matsuzawa, N., Takamura, T., Kurita, S., Misu, H., Ota, T., Ando, H., Yokoyama, M., Honda, M., Zen, Y., Nakanuma, Y., Miyamoto, K. and Kaneko, S. (2007). Lipid-induced oxidative stress causes steatohepatitis in mice fed an atherogenic diet. *Hepatology*, 46: 1392–1403.

Mountzouris, K., Tsitrsikos, P., Palamidi, I., Arvaniti, A., Mohn, M., Schatzmayr, G. and Fegeros, K. (2010). Effects of probiotic inclusion levels in broiler nutrition on growth performance, nutrient digestibility, plasma immune-globulins, and cecal microflora composition. *Poultry Science*, 89(1): 58–67.

Navid, H. M. (2010). Effect of probiotics bacteria utilization on serum biochemistry and triglyceride contents and performance of broiler chicken. *Global Veterinaria*, 5(3): 184 – 186.

Oviedo-Rondón, E. O., Hume, M. E., Barbosa, N.A., Sakomura, N.K., Weber, G. and Wilson, J.W. (2010). Ileal and cecal microbial populations in broilers given specific essential oil blends and probiotics in two consecutive grow-outs. *Avian Biology Research*, 3(4): 157-169.

Ovimaps, (2017). Ovi location map; ovi earth imaginary.

Pei, H. W., Ya, H. K., Hong, J. C., Chichen, H., Ding, S. T. and Ching, Y. C. (2009). The effect of feed restriction on expression of hepatic lipogenic genes in broiler chickens and the function of SREBP1. *Comparative Biochemistry and Physiology*, Part B. 153: 327–331.

Qaisrani, S. N., Van Krimpen, M. M., Kwakke, R. P., Verstegen, M. W. A. and Hendriks, W. H. (2015). Diet structure, butyric acid,

and fermentable carbohydrates influence growth performance, gut morphology, and cecal fermentation characteristics in broilers. *Poultry Science*, 94: 2152–2164.

Quinteiro-Filho, W. M., Ribeiro, A., Ferraz-de-Paula, V., Pinheiro, M. L., Sakai, M., As, L. R., Ferreira, A. J. and Palermo-Neto, J. (2010). Heat stress impairs performance parameters, induces intestinal injury, and decreases macrophage activity in broiler chickens. *Journal of Poultry Science,* 89: 1905-1914.

Quinteiro-Filho, W. M., Gomes, A. V., Pinheiro, M. L., Ribeiro, A., Ferraz-de-Paula, V., Astolfi-Ferreira, C.S., Ferreira, A. J. and Palermo-Neto, J. (2012). Heat stress impairs performance and induces intestinal inflammation in broiler chickens infected with Salmonella Enteritidis. *Journal of Avian Pathology,* 41: 421-427.

Ramin, M., Hamideh, S., Pegah, A. and Omidreza, F. (2012). Alterations in oxidative stress biomarkers associated with mild hyperlipidemia and smoking. *Food and Chemical Toxicology*, 50: 920–926.

S.A.S. (2002). Statistical Analysis System Institute, User's Guide. Version 9 for Windows. North Carolina, U.S.A.

Sino, S., Ingale, S. L., Kim, Y. W., Kim, J. S., Kima, K. H., Lohakarea, J.D., Kim, E.K., Kim, H. S., Ryu, M. H., Kwon, I. K. and Chae, B. J. (2012): Effect of supplementation of *Bacillus subtilis* LS 1-2 to broiler diets on growth performance, nutrient retention, caecal microbiology and small intestinal morphology. *Research in Veterinary Science,* 93: 264–268.

Song, Z., Cawthon, D., Beers, K. and Bottje, W.G. (2000). Hepatic and extra-hepatic stimulation of glutathione release into plasma by norepinephrine in vivo. *Poultry Science*, 79: 1632–1639.

Uzochukwu, I. E., Amaefule, B. C., Udeh, F. U., Dim, C. E., Tarinipre, G. and Ezekwe, A.G. (2015). Effect of probiotics (*Lactobacillus acidophilus*) on growth performance and serum lipid profile of finisher broilers. *Proceeding 20th Annual Conference of Animal Science Association of Nigeria (ASAN)* held at the University of Ibadan. Sept., 6 – 10. Page 578 – 582.

Zhang, Z. and Kim, I. (2014). Effects of multi-strain probiotics on growth performance, apparent ileal nutrient digestibility, blood characteristics, cecal microbial shedding, and excreta odor contents in broilers. *Poultry Science,* 93(2): 364–370.