MEAT QUALITY CHARACTERISTICS OF BROILERS FED PROBIOTICS FEED SUPPLEMENT

Adebiyi Olufemi A.
Department of Animal Science, University of Ibadan
Corresponding Author: femibiyi01@yahoo.com

ABSTRACT

*The present work evaluated the meat quality of broilers fed diets supplemented with a commercial probiotic (Growup, containing **Lactobacillus sporonginas** and **Saccharomyces cerevisae**). One hundred and fifty Abor Acre broiler chicks were distributed to five treatments and three replicates in each treatment (ten birds in each replicate), and reared on litter. Each treatment was randomly assigned to one of the experimental diets, which consisted of a Control, 0 ; T1, 0.02; T2, 0.04; T3, 0.06 and T4, 0.08 g of probiotic/100g feed in a completely randomized design. Feed intake, weight gain, feed conversion ratio, cooking loss and water holding capacity were determined. Data were analysed using the analysis of variance (ANOVA) procedure of SAS, 1999.*

There were no significant differences in weight gain due to effect of diets. Feed conversion ratio was higher (P <0.05) in birds on T4. Cooking loss of meat in the probiotics supplemented diets was reduced. The water holding capacity increased with increase in the probiotics supplementation from 42 in the control to 63 % in T4 for the breast muscle and from 43 in the control to 63.3% in T4 for the thigh.

From the results of the study, it was concluded that the inclusion of the probiotic at 0.08 g/100g feed for broiler chicks had beneficial effect on the growth performance and meat quality.

Key words: Probiotics, broiler, meat characteristics, performance

INTRODUCTION

There is currently a global trend to reduce the use of antibiotics in animal feed due to the contamination of meat products with antibiotic residues (Menten, 2001), as well as the concern that some therapeutic treatments for human diseases might be jeopardized due to the appearance of resistant bacteria (Dale, 1992). Recently, alternatives for substituting these traditional growth promoters have been evaluated and probiotics have been the most studied.

Probiotic represents a single or mixed culture of live microorganisms which when applied to animals, affects the host beneficially by improving the properties of indigenous microflora (Hong *et al.*, 2005). Probiotics come under the category of Generally Recognized as Safe (GRAS) ingredients as classified by the Food and Drug Administration (FDA), United States of America. They have no side and residual effects. Probiotics regulate the microbial environment in the gut, reduce digestive upsets and prevent pathogenic gut bacteria, thereby improving live weight gain, feed conversion ratio, egg production in layers and they reduce mortality. Probiotics commercially available contains strains of genera *lactobacillus, Bifidobacterium, Streptococcus, Bacillus, Bacteroides, Pediococcus, Leuconostoc, Propionibacterium, Saccharomyces cerevisiae and Aspergillusoryzae* (Chaucheyras *et al.*, 1995). *In-vitro* and *in-vivo* studies have demonstrated that lactic acid producing bacteria are able to inhibit the growth of poultry pathogen like *Salmonella* and *E. coli* by lowering the pH of the gut (Kung, 2001; Lee *et al.*, 2003; Frizzo *et al.*, 2010).

The development of favourable microflora in the gut of poultry can be enhanced by using probiotic especially during period of stress

(Krehbiel *et al.*, 2003). Consumption of contaminated feed, bad weather, poor management, transportation, poor housing conditions, changes in feed, presence of aflatoxins in feed, prolonged antibiotic therapy and disease stress are some of the factors that cause poor animal performance. Benefits of probiotics include enhanced survival of chicks, reduction or prevention of gastrointestinal disorders, increased growth rate, improved feed efficiency, enhanced immune response and reduced ammonia gas emission in broiler house etc. The use of probiotics for meat and carcass quality improvement has been questioned and many unclear results have been shown. Some authors reported advantages of probiotic administration (Maruta, 1993; Corrêa *et al.*, 2000; Vargas *et al.*, 2002) in poultry, while others did not observe improvement when probiotics were used (Owings *et al.*, 1990; Quadros *et al.*, 2001) in broilers. Therefore, the objective of the present study was to investigate the effects of different levels of probiotics on meat quality of broilers.

MATERIAL AND METHODS

A total of 150 seven-day-old chicks (Abor Acre strain) with mean body weight ranging from 0.13kg to 0.14kg were distributed into five treatments with three replicates in each treatment and ten birds in each replicate in a completely randomized design. Different level of probiotics feed supplement were included in the diet as follows: Control, 0; T1, 0.02; T2, 0.04; T3, 0.06 and T4, 0.08 g of probiotic/100g feed. (Please describe the probiotic used with regards to name and the live microbial contents). The management of the birds was as outlined by Oluyemi and Robert, (1979).

The gross composition of starter and finisher diets are shown in Table 1. Feed intake, weight and were taken weekly and values used to calculate feed conversion ratio. At the end of 8 weeks, four birds from each replicate were sacrificed for cooking loss and water holding capacity (WHC) evaluation. The cooking loss and WHC were determined using the following formulae, respectively:

Cooking loss =
weight before cooking – weight after cooking x 100/weight before cooking

WHC = $100 - \frac{[(Ar - Am) \times 9.47)]}{Wm \times Mo} \times 100$

Where:
Ar = Area of water released from the meat (cm^2):
Am = Area of meat sample (cm^2);
Wm = Weight of meat (mg);
Mo = Moisture content of the meat;
9.47 = constant factor

Data were analysed using analysis of variance (ANOVA) procedure of SAS, 1999.

Table 1 showed the gross nutrient composition (starter and finisher) of broiler birds fed diets supplemented with probiotics. The feeds were formulated to meet the nutritional composition of broilers as recommended by NRC, 1994.

RESULTS

The results of growth performance are shown in Table 2. No significant difference was observed in the weight gain with the values ranging from 1.88kg to 2.15kg. However, birds fed diet T4 had the least feed conversion ratio of 2.28 compared with 2.33, 2.37, and 2.74 for the control, T1, and T3, respectively.

The results of meat quality characteristics are shown in Tables 3 and 4. There was significant response in cooking loss and WHC of breast muscle, drumstick and thigh muscle of the birds to dietary probiotic supplementation. Birds fed the diet T4 had the least ($P < 0.05$) value for cooking loss for breast muscle, drumstick and thigh muscle compared with the rest diets. However, the WHC increased with the inclusion of the probiotics. Birds on the control diet had the highest WHC for all the different carcass parts compared with those on the probiotic supplemented diets except for the thigh muscle.

DISCUSSION

The present study showed that supplementation of diet with the probiotic used at level of 0.8g/100g improved the performance of the broiler chickens in terms of weight gain and feed conversion ratio. Study conducted by

Nocek *et al.* (2002) and Frizzo *et al.* (2010) demonstrated that the use of probiotics in the feed or body of animal exploit the potential of utilisation of feed and improves the efficiency of feed utilisation by inhibiting the growth of pathogens like Salmonella and *E. coli* through the lowering of the pH of the gut. Hossain *et al.* (2006) and Khaksefidi and Ghoorchi (2006) also confirmed the beneficial nature of probiotics by increase in the live weight gain of birds fed probiotics supplemented diets. The observation in the resent study was also in line with Manna *et al* (2003) and Sharma *et al* (2003) who reported that broiler diets supplemented with probiotics showed improved feed intake than those on the control diet. Gupata *et al.* (2003), Karaoglu and Durdag (2005), Dea *et al.* (2006) and Onderci *et al.* (2008) reported that birds fed with probiotics had significantly improved feed to gain ratio. In contrast however, Ergun *et al.* (2000) reported that supplementation of probiotics had no effect on the performance of broiler chicks.

Cooking loss and WHC showed significant ($P < 0.05$) differences in the breast, drumstick and thigh muscle among the birds fed the experimental diets. The cooking loss decreased and WHC increased in the different carcass parts in birds on the probiotic supplemented diets. This is so because of the reduced pH associated with probiotic. Increase in the probiotics to 0.08g/100g feed (diet T4) could have resulted in a further reduction in the pH. Forrest *et al.*(1975) stated that muscle transforms into meat due to some biochemical processes, among them is the alteration in pH which is close to 7.4 *in vivo*. Sanudo (1992) confirmed that meat quality is influenced by alteration that occurs in the pH during rigor mortis. The reversed relationship between the cooking loss and the WHC is expected because increase in the cooking loss will result in the reduction in nutritional value of the meat as some nutrients may be lost in the exudates resulting in meat being less tend and with resultant bad flavour. In contrast to the results obtained in this study, Pelicano *et al.* (2003) reported that the WHC and cooking loss were not different among probiotics fed birds and birds on control diets. Kabir (2005) and Kabir *et al.* (2005) also reported improvement in meat quality at both at prefreezing and post freezing storage as a result of supplementation broiler diets with probiotics.

Conclusion

It could be concluded that supplementation of broiler diets with 0.08g probiotic/100g feed improved the performance of broilers and meat quality from the birds.

Table 1: GROSS COMPOSITION OF EXPERIMENTAL DIETS

Diet	Control	T1	T2	T3	T4	SEM
Amount of probiotic, g/100g	**0**	**0.02**	**0.04**	**0.06**	**0.08**	
Parameter, %						
Breast ,	33.03^{a}	27.16^{b}	25.00^{b}	28.22^{b}	16.23^{c}	2.56
Drumstick	48.08^{a}	40.63^{b}	37.23^{c}	31.93^{c}	22.50^{d}	2.34
Thigh	46.43^{a}	37.27^{b}	35.84^{bc}	30.04^{c}	19.09^{d}	2.13

^{ab}Means within the same row without common superscripts differ significantly ($p<0.05$)

Table 2: Performance of broiler chickens fed probiotic supplemented diets

Parameters	Control	T1	T2	T3	T4	SEM
Amount of probiotic, g/100g	**0**	**0.02**	**0.04**	**0.06**	**0.08**	
Initial weight (kg/bird)	0.14	0.14	0.14	0.13	0.14	
Final weight (kg/bird)	2.02^{c}	2.29^{a}	2.05^{c}	2.18^{b}	2.04^{c}	0.18
Weight gain (kg/bird)	1.88^{c}	2.15^{a}	1.91^{c}	2.05^{b}	1.90^{c}	0.18
Feed Intake (kg/bird)	5.12^{a}	5.13^{a}	4.31^{b}	4.74^{b}	4.30^{b}	0.41
Feed Conversion Ratio	2.74^{a}	2.37^{b}	2.28^{b}	2.33^{b}	2.28^{b}	0.19

Means within the same row without common superscripts differ significantly ($p<0.05$)

Table 3: Cooking loss of carcass part in broilers fed probiotic supplemented diets

Diet	Control	T1	T2	T3	T4	SEM
Amount of probiotic, g/100g	0	0.02	0.04	0.06	0.08	
Parameter, %						
Breast ,	33.03^{a}	27.16^{b}	25.00^{b}	28.22^{b}	16.23^{c}	2.56
Drumstick	48.08^{a}	40.63^{b}	37.23^{c}	31.93^{c}	22.50^{d}	2.34
Thigh	46.43^{a}	37.27^{b}	35.84^{bc}	30.04^{c}	19.09^{d}	2.13

^{ab}Means within the same row without common superscripts differ significantly ($p<0.05$)

Table 4: Water holding capacity of carcass part in broilers fed probiotic supplemented diets

Diet	Control	T1	T2	T3	T4	SEM
Amount of probiotic, g/100g	0	0.02	0.04	0.06	0.08	
Parameters (%)						
Breast	42.00 ^{c}	49.00 ^{c}	54.67 ^{b}	57.67 ^{b}	63.00 ^{a}	4.17
Drumstick	43.33 ^{b}	47.00 ^{b}	52.00 ^{ab}	51.67 ^{ab}	63.33 ^{a}	4.48
Thigh	46.67	43.67	44.67	47.67	44.67	2.43

^{ab}*Means within the same row without common superscripts differ significantly ($p<0.05$)*

REFERENCES

Corrêa G.S.S., Gomes A.V.C., Corrêa A.B, Salles A.S (2000). Desempenho de frangos de corte alimentados com diferentes promotores de crescimento. In:Reunião Anual da SBZ, Viçosa. p. 37.

Chaucheyras, F., G. Fonty, G. Bertin, J.M. Salmon and P. Gouet., 1995. Effects of strain of Saccharomyces cerevisiae (a microbial additive for ruminants, on lactate metabolism in vitro. Can. J. Microbiol., 42: 927-933.

Dale N (1992). Probióticosparaaves. Avicultura Professional 10(2): 88-89.

Dea, E.E., G.M. Fesenko, G.E. Allison, D.R. Korver, G.W. Tannock and L.L. Guan, 2006. Investgating the effects of commercial probiotics on broiler chick quality and production efficiency. Poult. Sci. 85: 1855-1863

Ergun, A., S. Yalcin and P. Sacakli, 2000.The usage of probiotic and zinc bacitracin in broiler rations. Ankara Universitesi Veteriner Fakultesi Dergisi., 47: 271-280.

Forrest, J.E.D., C. Aberle, H.B. Herdrich, M.D.. Judge and R.A. Merkel, 1975. Principle of meat science. Freeman, San Franscisco, Califonia, 417.

Frizzo, L.S., L.P. Sotto, M.V. Zbrum, E. Bertozzi, G. Sequeria, R.R. Armesto and M.R. Rosmini, 2010. Lactic acid bacteria to improve growth performance in young calves fed milk replacer and spray-dried whey powder. Anim. Feed Sci. Technol., 157: 159-167.

Gupta, M., K.S. Sharma, P. Gupta, K. Meena and R. Desv, 2003. Effect of intermittent dietary supplementation of different combinations of microbial strains, on the biological performance of commercial layer chicken. Proceeding of the 12th Conference of Indian Poultry Science Association and National Symposium on Diversification of Poultry for Nutritional Security Izatnagar, India, March 27-28 pp 112-112

Hong, H.A., L.H. Duc and S.M. Cutting, 2005.The use of bacterial spore formers as probiotics. FEMS Microbiol. Rev., 29: 813-835.

Hossain, M.A.; Ali, M.A.; Chowdhury, S.D.; Haque, M.A.; Kabir, S.M.L. 2005, Effect of yoghurt and protexin boost on gut microflora and broiler performance. *The Agriculturists 3*, 24-29.

Kabir S.M.L., Rahman M.M., Rahman M.B..2005 Potentiation of probiotics in promoting microbiological meat quality of broilers. J. Bangladesh Soc. Agric. Sci. Technol.2:93–96.

Kabir S.M.L.. 2005. The Dynamics of Probiotics in Enhancing Poultry Meat Production and Quality. MS thesis. Department of Microbiology and Hygiene, Faculty of Veterinary Science, Bangladesh Agricultural University.

Karaoglu, M. and H. Durdag, 2005. The influence of dietary probiotics (*Saccharomyces cerevisiae*) supplementation and different slaughter age on the performance, slaughter and carcass properties of broilers. Int. J. Poult Sci, 5: 309-316

Khaksefidi A, Ghoorchi T. 2006 Effect of probiotic on performance and immuno-competence i n broiler chicks. J. Poult. Sci.;43:296–300.

Krehbiel, C.R., S.R. Rust, G. Zhang and S.E. Gilliland, 2003. Bacterial direct-fed Microbials in ruminant diets: Performance response and mode of action. J. Anim. Sci., 81: 120-132.

Kung, L.Jr., 2001. Direct-fed microbials for dairy cows and enzymes for lactating dairy cows: New theories and application. Proceedings of the Pennsylvania State Dairy Cattle Nutrition Workshop (DCN'01), Grantville, PA., pp: 86-102.

Lee, Y.K., K.Y. Puong, A.C. Ouwehand and S. Salminen, 2003. Displacement of bacterial pathogens from mucus and caco-2 cell surface by lactobacilli. J. Med. Microbiol., 52: 925-930.

Manna, R., M.C. Pakhira and G. Samanta, 2003. Graded replacement of dietary fishmeal and use of probiotics on the performance of Japanese quail. Proceedings of the 12th Conference of Indian Poultry Science Association and National Symposium on Diversification of Poultry for Nutritional Security Izatnagar, India, March 27-28 pp 109-109

Maruta K. 1993. Probióticos e seus beneficios. In:Conferência APINCO de Ciência e Tecnologia Avícolas; Santos, São Paulo. Brasil. pp. 203-219.

Menten J.F.M. 2001. Aditivosalternativo snanutrição deaves: Probióticose Prebióticos. Sociedade Brasileira de Zootecnia, Aprodução animal navisão dos brasileiros, Piracicaba: Fealq, pp. 141-157.

Nocek, J.E., W.P. kautz, J.A.Z. Leedle and J.G. Allman, 2002. Ruminant supplementation of direct-fed microbials on diurnal pH variation and in situ digestion in dairy cattle. J. Dairy Sci., 85: 429-433.

NRC, National Research Council, 1994. Nutrients Requirements of Poultry. 9. Edn. Washington D.C., USA.

Oluyemi, J.A. and E.A. Roberts 1979. *Poultry production in warm and wet climates. Macmillan Press London.*

Onderci, M., N. Sahin, G.Cikim, A. Aydyn and I. Ozercan 2008, α-glucanase-producing bacterial culture improves performance and nutrient utilisation and alter gut morphology of broilers fed barley-based diet. Anim. Feed Sci. Technol., 146: 87-97

Owings, W.J., Reynoldas D.L, Hasiak R.J, Ferket P.R. 1990. Influence of dietary supplementation with *Streptococcus faecium* M-74 on broiler body weight, feed conversion, carcass characteristics, and intestinal microbial colonization. Poult. Sci. 69: 1257-1264.

Pelicano, E.R,. P.A.D.De Souza, H.B. DeSouza, A.Oba, E.A. Norku. L.M.Kodawara and T.M. Lima 2003. Effect of different probiotics on broiler carcass and meat quality. Rev. Bras.Cienc .Avic 5(3):1-14

Quadros A.R.B., Kiefer C, Ribeiro N.L.C., Zink L.A. 2001. Caracteristicas qualitativas da carne de suínos alimentados com rações contendo ou não probióticos. In:XXXVIII Reunião Anual da SBZ, Piracicaba. Anais. Piracicaba, pp. 794-795

Rose, A.H., 1987. Response to the Chemical Environment. In: The Yeasts, Rose, A.H. and J.S. Harrison (Eds.). Academic Press, London,pp: 5-40.

SAS, 1999. SAS/STAT User's Guide: 8.2 edition, Statistical Analysis System Institute, Inc., Cary, North Carolina, USA.

Sharma, K.S., M. Gupta, K. Meema and G. Singh, 2003. Biological performance of commercial Broiler fed diets supplemented with microbial strain isolated from indigenous sources. Proceeding of the 21st Conference of Indian Poultry Science Association and National Symposium on Diversification of Poultry for Nutritional Security Izatnagar, India, March 27-28 pp 112-112

Saundo, C., 1992. La calidad organoleptica de la crane (ii). Mundo ganadero, 10:78-86

Vargas Jr. J.G., Toledo R.S., Albino L.F.T., Rostango H.S., Oliveira J.E., Carvalho D.C.O. 2002. Caracteristicas de carcaça de frango de corte, submetidos a rações contendo probióticos, prebióticos e antibióticos. In: XXXIX Reunião Anual da SBZ, Recife. *Anais*. Recife, CD ROM