INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
24–0255/2024/32–6–580–584
DOI: 10.17957/IJAB/15.2238
http://www.fspublishers.org

Full Length Article

Supplementation of *Dialium guineense* Bark and *Saccharomyces cerevisiae* on Carcass Yield, Gut Morphology and Visceral Organs of Ross 308 Broilers

Ifeanyichukwu Princewill Ogbuewu[1,2*†], Monnye Mabelebele[2†] and Christain Anayo Mbajiorgu[2†]
[1]*Department of Animal Science and Technology, Federal University of Technology, P.M.B. 1526, Owerri, Imo State, Nigeria*
[2]*Department of Agriculture and Animal Health, University of South Africa, Florida Science Campus, Private Bag X6, Florida 1710, South Africa*
[*]For correspondence: dr.ogbuewu@gmail.com; ifeanyi.ogbuewu@futo.edu.ng
[†]Contributed equally to this work and are co-first authors
Received 23 May 2024; Accepted 22 June 2024; Published 07 November 2024

Abstract

The current study aimed to determine the influence of a 10:1 mixture of *D. guineense* bark meal and *S. cerevisiae* (DBSC) on carcass characteristics, visceral organ weight, and gut morphology of broilers. A total of 180, one-day-old Ross 308 broilers were randomly distributed into three equal treatments with 5 replicates of twelve broiler chickens per pen. Each treatment was allotted to basal diets [starter (1–28 days) and finisher (29–56 days)] supplemented with DBSC designated DBSC (0 g/kg feed), DBSC (0.5 g/kg feed), and DBSC (1.0 g/kg feed) in a completely randomized design. Results show that DBSC supplementation increased ($P < 0.05$) de-feathered and live weights. Conversely, DBSC supplementation supported dressed percentage in broilers. In comparison with the control group, broilers in the 0.5 g/kg feed group had increased visceral fat weight and reduced thigh weight. Proventriculus weight decreased with increasing supplementation levels of DBSC in the feed. Dietary DBSC inclusion had no significant effect ($P > 0.05$) on the weights of the liver, kidney, heart, and kidney of broilers. The gut morphological parameters of broilers given DBSC supplemented diets were not significant ($P > 0.05$). Incorporating DBSC up to1.0 g/kg supported carcass yield, visceral organ and gut morphometric development in broilers had no significant effect ($P > 0.05$) on live body weight. Therefore, DBSC up to1.0 g/kg can improve carcass yield, aspects of visceral organ weight and gut morphometry in broilers and could be utilised as a valuable feed supplement.

Keywords: Broilers; *Dialium* bark; Yeast; Carcass; Organs; Gut morphology

Introduction

The target of the modern poultry industry is to improve productivity and optimise feed conversion. One way to achieve this is by using feed additives such as prebiotics, exogenous enzymes, and phytogenic feed additives (PFAs). Among these feed additives, PFAs (plant materials added to the feed at recommended levels to improve productivity) have demonstrated some potential in this regard in broilers and constitute an essential part of modern feeding practices. Phytogenic feed additives, especially those derived from the barks of several tropical medicinal plants, have gained interest as a possible growth promoter in broiler production (Barreto *et al.* 2008; Ogbuewu and Mbajiorgu 2023). One such PFA that has attracted attention in broiler nutrition is *Dialium guineense* called black velvet tamarind in English (Ogbuewu and Mbajiorgu 2023; Ogbuewu and Mbajiorgu 2024). *Dialium guineense* is a shrub that is available in the tropics. It has a straight, smooth stem with a greyish colour. The plant has different parts, such as the seed, leaves, roots, and bark. The bark contains several important nutrients and bioactive compounds that give it inherent potential in the treatment of cough, toothache, and bronchitis. It has been reported to serve as an antimicrobial and antioxidant agent in humans and animals (Olajubu *et al*. 2012). Furthermore, *D. guineense* bark like most tree bark contains bioactive phytochemical compounds (Olajubu *et al*. 2012) which may positively affect nutrient utilisation, product quality, and physiological indices in animals. However, the addition of *D. guineense* bark to broiler diets at a level above 0.5 g/kg affected performance negatively. This observation may be attributed to its high fibre value (≤ 6%), lignocellulose, and presence of some anti-physiological agents such as trypsin inhibitors, cyanogenic glycosides, and tannins (Ogbuewu and Mbajiorgu 2023).

To cite this paper: Ogbuewu IP, M Mabelebele, CA Mbajiorgu (2024). Supplementation of *Dialium guineense* bark and *Saccharomyces cerevisiae* on carcass yield, gut morphology and visceral organs of ross 308 broilers. *Intl J Agric Biol* 32:580–584

Based on the aforementioned limitations to the use of *D. guineense* bark, especially supplementation doses above 0.50 g/kg (Ogbuewu and Mbajiorgu 2023; Ogbuewu and Mbajiorgu 2024), there is a need to improve the supplemental level via supplementation using other forms of additives that have mechanisms that can degrade high fibre content and anti-physiological agents. In recent decades, the use of probiotics such as baker's yeast (*Saccharomyces cerevisiae*) has gained a lot of research interest (Qui 2023). The reason behind this increasing research interest in the *S. cerevisiae* supplementation in high-fibre diets of broilers owing to the ability of the probiotic *S. cerevisiae* to improve digestion of nutrients and degradation of fibre as a result of its ability to produce digestive enzymes (Ghazanfar *et al*. 2017; Elghandour *et al*. 2020). In addition, it contains essential nutrients, α-D-mannan, chitin, and *β*-D-glucan that improve chicken performance (Haldar *et al*. 2011). The direct nutrient effects in combination with other modes of action of *S. cerevisiae* confirmed its efficacy in improving animal performance and enhancing intestinal microbiota composition (Zhang *et al*. 2005; Qui 2023). Thus, it will be worthwhile to ascertain the physiological effect of a mixture of *D. guineense* bark and *S. cerevisiae* (DBSC) supplementation on broiler performance. Hence, the present feeding study aims to assess carcass yields, visceral organ weights, and gut morphology of broilers fed DBSC supplement.

Materials and Methods

Experimental location, ethics and preparation of test materials

This study got approval from the Small Animal Ethics Committee of the Federal University of Technology Owerri (FUTO) Nigeria (Ref. #: 2023/AST_AREC/134). The trial was performed at the Small Animal Section of the FUTO. The experimental site lied in the tropical rainforest zone of Nigeria with a mean daily temperature range of 28–32°C, and an average relative humidity range of 75–80%. The *D. guineense* bark used for the study was harvested and processed into meals following the methods described by Ogbuewu and Mbajiorgu (2023). Baker's yeast and other feedstuffs were bought from a known feed raw material dealer in Owerri, Imo State. The constituent of the *D. guineense* bark used for the present study has been reported by Ogbuewu and Mbajiorgu (2023).

Experimental diets and birds

Two experimental rations (Table 1) were compounded and supplemented with a 10:1 mixture of *D. guineense* bark and *S. cerevisiae* (DBSC) at DBSC at 0, 0.5 and 1.0 g/kg to meet the nutrient specifications of Ross 308 (Aviagen, 2019). Experimental birds received a starter diet (1–28 days) and a finisher diet (29–56 days). Ross 308 chicks (n = 180) were distributed to three treatments of five replicates with each pen containing 12 broilers. The experimental chicks have unlimited access to feed and drinking water.

Data collection

On the 56th day of the investigation, one broiler was randomly selected for each replicate and deprived of ration overnight before individual live weight was taken using an electronic weighing balance (Model: HESA 3303). Thereafter, birds were killed by cervical dislocation. After this, the slaughtered birds were scalded in hot water for 10 seconds, de-feathered, eviscerated, weighed, and carcass weight was determined. The visceral organs were separated, and the carcass cut into its respective parts following the methods of the USDA (1989). Carcass, visceral fat and organs were weighed using a digital electronic scale (Sensitivity: 0.01 g; model: G-SF-400C) and expressed as a proportion of body weight. Intestinal lengths and weights were determined as previously reported by others (Maoba *et al*. 2021; Ogbuewu and Mbajiorgu 2024).

Statistical analysis

The data obtained on carcass yield, visceral organ weight, intestinal lengths, and weights were expressed as means, standard error, and standard error of the mean and assessed by analysis of variance following the General Linear Model procedure of SPSS software (SPSS 2010). The Tukey test was used to determine differences between significant means. Differences were deemed significant at the 5% probability level.

Results

Results of dietary DBSC supplementation on carcass and cut-part weights of broilers are presented in Table 2. In comparison with the control diet, broilers on treatment diets had better ($P < 0.05$) live and de-feathered weights. Similar ($P > 0.05$) live and de-feathered weights were returned for broilers fed supplemental DBSC at 0.5 and 1.0 g/kg. No statistical differences ($P > 0.05$) were observed for the weights of drumstick, breast, and dressed percent among treatment groups. However, broiler chickens in the control group had the highest thigh weight, which was comparable to the weight of broilers in the 1.0 g/kg group but was significantly higher ($P < 0.05$) than values obtained from those in the 0.5 g/kg group. Birds in the 1.0 g/kg group have reduced ($P < 0.05$) visceral fat weight compared to broilers in the 0.5 g/kg group.

Table 3 shows the effects of DBSC supplementation levels on the relative visceral organ weights of broilers. The weights of the proventriculus and kidney decreased progressively as the levels of DBSC were increased in the diets. However, the recorded decline was not statistically significant ($P > 0.05$). On the other hand, liver weight

Table 1: Composition of the basal diets for the Ross 308 broilers

Ingredients (g/kg)	Starter (days 1 – 28)	Finisher (days 29 – 56)
Corn	540	600
SBM	300	250
Spent grain	20	10
Wheat offal	40	30
Bone meal	30	35
Oyster shell	10	15
Premix[1]	2.5	2.5
Nutrient composition (g/kg)		
CP	239.0	203.9
ME (Kcal/kg)	2823	2823
CF	40.8	42.8
Crude fat	41.2	44.4
Ash	16.5	16.6
Calcium	16.3	16.5
Phosphorus	11.3	11.4

All diets contained palm kernel cake (50 g/kg), salt (2.5 g/kg), lysine (2.5 g/kg) and methionine (2.5 g/kg). [1]Premix provided per kg of ration: vitamin D3 - 100 i.u; vitamin C - 2.40 g, vitamin E – 8 g; vitamin K - 0.4 g; vitamin B1- 0.3 g; vitamin B2, 1.0 g; vitamin B6 - 0.6 g; vitamin A - 2, 000,000 i.u; vitamin B12 - 40 g; manganese - 160 g; iron, 8.0 g; zinc - 7.2 g; copper - 0.3 g; iodine, 0.25 g; cobalt - 36.0 mg; selenium -16.0 mg; CP –crude protein; SBM –soybean meal; ME – metabolisable energy; CF – crude fibre

Table 2: Impact of supplemental DBSC diets on carcass parameters of broiler chickens

Parameters	Inclusion levels of DBSC (g/kg)			Mean	SEM	*P* value
	0	0.5	1.0			
LW (g)	2190.00^b	2410.00^a	2390.00^a	2330.00	10.16	0.032
DFW (g)	2060.00^b	2230.00^a	2250.00^a	2180.00	15.15	0.029
Dressed percent	68.11	66.58	68.17	67.62	0.56	0.486
BW % LW	23.99	25.17	24.28	24.48	0.64	0.790
TW % LW	11.46^a	10.22^b	10.87^{ab}	10.85	0.22	0.049
DW % LW	10.33	10.33	11.15	10.60	0.27	0.424
VFW % LW	0.63^b	1.25^a	0.44^b	0.77	0.25	0.024

^{a,b} Means with different letters within the same row differed significantly (*P* < 0.05). LW = live weight; BW = breast weight; TW = thigh weight; DW = drumstick weight; VFW = visceral fat weight; DFW = de-feathered weight; SD = standard deviation; SEM = standard error of the mean; P = probability

decreased significantly (*P < 0.05*) with incremental supplementation levels of DBSC. The gut morphological traits of broilers fed basal diets supplemented with DBSC are illustrated in Table 4. The results show that duodenum, jejunum, and ileum weights were not influenced by DBSC supplementation levels. Similarly, dietary DBSC (*P > 0.05*) did not affect the lengths of the large intestine of broilers among the dietary groups. There were no significant differences (*P > 0.05*) on the lengths of duodenum, jejunum, and ileum across the three groups.

Discussion

There are significant differences in live weight and de-feathered weights among the broilers. Those offered DBSC at inclusion levels of 0.5 and 1.0 g/kg have higher live weights than those at the 0 g/kg inclusion level. This implies that DBSC supplementation promotes feather formation and development in broilers. Cystine and methionine are the main sulphur-containing amino acids involved in feather formation and development (Leeson 2021). This finding implies that DBSC may be high in cystine, which, according to Leeson (2021), is the most common amino acid in feathers, comprising about 9% of total amino acids. However, the amino acid characteristics of DBSC should be determined, as such information is lacking in the literature. The diet of a chicken affects its carcass characteristics (Kaushal *et al*. 2019). The results indicate that the dressed percentage recorded in this experiment was similar to the dressed percent recorded in Ross 308 fed supplemental *D. guineense* bark (Ogbuewu and Mbajiorgu 2024). Results also support the findings of Tugiyanti and Susanti (2022) that probiotics and phytogenics and their combinations did not influence carcass yield and cut-part weights in broilers. However, this contrasted with the findings of Ogbuewu and Mbajiorgu (2024), who noticed that carcass weights in broilers were affected by *D. guineense* bark. The increased dressed percent in broilers fed 1.0 g DBSC/kg implies the ability of *S. cerevisiae* contained in the DBSC to modulate gut microbiota and increase nutrient utilisation by the broilers.

The experiment indicates that the test supplement had no deleterious effect on breast and drumstick weight in broilers. However, the decreased thigh weight in broilers fed DBSC at 0.5 g/kg could be linked to the fibrous nature of the test feed supplement and the inability of baker's yeast to improve fibre digestion, resulting in poor nutrient utilisation and decreased thigh weight. In contrast, the similar thigh weight between birds on DBSC inclusion levels of 0 and 1.0 g/kg may be attributed to the *S. cerevisiae* effect, which may have reached a threshold needed to improve fibre digestion and nutrient utilisation by the broilers.

Table 3: Effect of DBSC on relative organ weights of broiler chickens

Parameters	Supplementation levels of DBSC (g/kg)			Mean	SEM	*P* value
	0	0.5	1.0			
FGW % LW	2.80	2.71	2.59	2.70	0.09	0.486
EGW % LW	1.98	1.99	1.81	1.93	0.08	0.699
PTW % LW	0.64	0.48	0.39	0.50	0.04	0.664
Liver % LW	2.29^a	2.11^{ab}	2.10^b	2.16	0.09	0.021
Lungs % LW	0.69	0.53	0.65	0.62	0.05	0.702
Heart % LW	0.52	0.53	0.48	0.51	0.03	0.514
Kidney % LW	0.12	0.17	0.14	0.14	0.03	0.758

^{a,b} Means with different letters within the same row differed significantly (*P < 0.05*). LW = live weight; = FGW = full gizzard weight; EGW = empty gizzard weight; PTW = proventriculus weight; SD = standard deviation; SEM = standard error of the mean; P = probability

Table 4: Effect of dietary DBSC on intestinal weight and lengths of broiler chickens

Parameters	Supplementation levels of DBSC (g/kg)			Mean	SEM	*P* value
	0	0.5	1.0			
LIW % LW	0.16	0.20	0.25	0.20	0.03	0.571
DW % LW	0.96	1.36	0.92	1.08	0.11	0.189
JW % LW	2.01	2.14	2.09	2.08	0.08	0.847
IW % LW	1.48	1.86	1.63	1.66	0.14	0.576
LLI (cm)	11.00	10.50	12.33	11.28	0.57	0.450
DL (cm)	38.17	40.00	41.00	39.72	0.66	0.224
JL (cm)	99.17	102.33	100.33	100.61	1.54	0.753
IL (cm)	98.00	103.00	110.67	103.89	2.72	0.159

^{a,b} Means with different letters within the same row differed significantly (*P < 0.05*). LW = live weight; LIW = large intestine weight; DL = duodenal length; DL = duodenal length; JL = jejunal length; IL = ileal length; IW = ileal weight; LLI = length of large intestine; JW = jejunal weight; SD = standard deviation; SEM = standard error of the mean; P = probability

The accumulation of visceral fat suggests inefficient use of dietary energy (Fouad and El-Senousey 2014). The significantly higher weight of visceral fat at 0.5 g/kg is an indication that dietary energy was not well utilised by the birds. This could also explain why the increased live weight of broilers at 0.5 g DBSC/kg supplementation did not translate into a higher dressed percentage. This observation shows that DBSC influences liver weight in broilers. This observation disagrees with Sangilimadan *et al.* (2020), who reported similar organ weights in chickens on dietary phytobiotic supplementation. A significant reduction of the liver weight seen in birds fed the DBSC-supplemented diets at 1.0% could be partly attributed to antinutritional factors present in *D. guineense* stem bark. It is likely that the dietary DBSC supplementation at 1.0 g/kg is beyond the threshold level the liver could utilise. Higher gizzard weight translates into higher grinding ability in chickens. The gizzard weight recorded in this investigation was relatively lower than the value (4.4% LW) recorded in indigenous chickens by Mabelebele *et al*. (2014). This observation agrees with the findings of Jamroz (2005) who demonstrated that broilers had a lower gizzard weight than indigenous chicken strains. This disparity could be attributed to the digestive tract's adaptability to handle fibrous feed. Furthermore, the results suggest that the lungs, kidney, and heart weight obtained in this study were the same among the treatment groups as the control, which is in agreement with Ogbuewu and Mbajiorgu (2023), who recorded similar lungs, kidney and heart weight in broilers. This implies that treatment diets promote the development of these important organs in broilers.

The chicken gut plays an important function in digestion and nutrient absorption. The present results show that weights of large intestine and small intestine were numerically higher in broilers fed DBSC-supplemented diets at 0.5 and 1.0 g/kg compared to those fed the same diet at 0 g/kg. The values obtained in this investigation were similar to the values previously reported in Ross 308 chickens by Mabelebele *et al*. (2014) but was slightly lower than the value recorded in indigenous Boschveld chickens (Maoba *et al*. 2021). This variation is to be expected given that broilers have been bred to reach market weight in a short period of time (Buzala *et al*. 2015). The increased lengths of duodenum, jejunum and ileum in broilers at 0.5 to 1.0 g/kg diet might be related to gastrointestinal tract adaptability to DBSC-supplemented diets. Although the ileal length is approximately the same as the jejunal length in the current experiment, the empty weight of the ileum is much lower than the empty weight of the jejunum. The increased empty weight of the jejunum could be linked to hyperplasia (increase in cell number) or hypertrophy (increase in cell size), as according to Svihus (2014), all the major nutrients are to a large extent digested and absorbed in the jejunum. The observed non-significant effect of the test supplement on the weights and lengths of the intestine is an indication that dietary DBSC did not have adverse effects on gut morphology.

Conclusion

It can be demonstrated that addition of a DBSC supplement at 1.0 g/kg to chicken feed improved live weight, de-feathered weight, and thigh weight without having negative effects on gut morphology, aspects of visceral organ weights, or carcass characteristics.

Acknowledgements

The authors acknowledge the staff of the e-Library of Federal University of Technology Owerri for their assistance.

Author Contributions

IPO, MM and CAM conceptualised and designed the experiment, IPO and MM data collected and analysis the data, MM, IPO and CAM interpreted the analysed result and wrote the manuscript.

Conflicts of Interest

There is no conflict of interest among the authors.

Data Availability

Data are available as tables without restriction.

Ethics Approval

The study was approved by the institutional ethics committee (Ref. #: 2023/AST_AREC/134).

Funding Source

Not applicable

References

Aviagen (2019). *Ross 308 Nutrient Specifications*. Available online at http://eu.aviagen.com/assets/Tech_Center/Ross_Broiler/RossBroilerNutritionSpecs2019-EN.pdf

Barreto MSR, JFM Menten, AMC Racanicci, PWZ Pereira, PV Rizzo (2008). Plant extracts used as growth promoters in broilers. *Rev Brasil Cienc Avic* 10:109–115

Buzala M, B Janicki, R Czarnecki (2015). Consequences of different growth rates in broiler breeder and layer hens on embryogenesis, metabolism and metabolic rate: A review. *Poult Sci* 94:728–733

Elghandour MMY, ZI Tan, SHA Hafsa, MJ Adegbeye, R Greiner, EA Ugbogu, JC Monroy, AZM Salem (2020). *Saccharomyces cerevisiae* as a probiotic feed additive to non and pseudo-ruminant feeding: A review. *J Appl Microbiol* 128:658–674

Fouad AM, HK El-Senousey (2014). Nutritional factors affecting abdominal fat deposition in poultry: A review. *Asian-Aust J Anim Sci* 27:1057–1068

Ghazanfar S, N Khalid, I Ahmed, M Imran (2017). Probiotic yeast: Mode of action and its effects on ruminant nutrition. *In: Yeast-Industrial Applications*, pp:179–202. Intech Open, London

Haldar S, TK Ghosh, MR Bedford (2011). Effects of yeast (*Saccharomyces cerevisiae*) and yeast protein concentrate on production performance of broiler chickens exposed to heat stress and challenged with *Salmonella enteritidis*. *Anim Feed Sci Technol* 168:61–71

Jamroz D (2005). Comparative Characteristic of Gastrointestinal Tract Development and Digestibility of Nutrients in Young Chickens, Ducks and Geese. *In: Proceedings of the 5th European Symposium on Poultry Nutrition*, pp:74–85. September 25–29, 2005. Balatonfured, Hungary

Kaushal S, RK Sharma, DV Singh, SK Shukla, S Kumar, J Palod, MK Singh (2019). Performance, carcass characteristics and economics of broiler chickens fed dietary enzymes and probiotic. *Iran J Vet Res* 20:293–298

Leeson S (2021). Effects of nutrition on feathering. Available online at https://www.poultryworld.net/specials/effects-of-nutritiononfeathering/#

Mabelebele M, OJ Alabi, JW Ng'ambi, D Norris, MM Ginindza (2014). Comparison of the gastrointestinal tract and pH values of digestive organs of Ross 308 broilers and Indigenous Venda chickens fed the same diet. *Asian J Anim Vet Adv* 9:71–76

Maoba S, IP Ogbuewu, JW Oguttu, CA Mbajiorgu (2021). Prediction of responses of indigenous Boschveld chickens to probiotic-yeast additive levels using a quadratic optimization model. *Trop Anim Hlth Prod* 53:48–58

Ogbuewu IP, CA Mbajiorgu (2024). Dose-related responses of broiler chickens to black velvet tamarind (*Dialium guineense*) stem bark supplementation: Carcass characteristics, organ weight and intestinal biometry. *Agroforest Syst* 98:245–254

Ogbuewu IP, CA Mbajiorgu (2023). Dietary *Dialium guineense* stem-bark supplementation improves growth performance and haemato-biochemical characteristics of broiler chickens. *Heliyon* 9:e17341

Olajubu F, I Akpan, D Ojo, S Oluwalana (2012). Antimicrobial potential of *Dialium guineense* (Wild.) stem bark on some clinical isolates in Nigeria. *Intl J Appl Basic Med Res* 2:58–62

Qui NH (2023). Baker's yeast (*Saccharomyces cerevisiae*) and its application on poultry's production and health: A review. *Iraq J Vet Sci* 37:213–221

Sangilimadan K, R Churchil, K Premavalli, ST Selvan, AV Omprakash (2020). Effect of phytobiotics supplementation on carcass characteristics of Nandanam broiler chickens. *Intl J Curr Microbiol Appl Sci* 9:1349–1358

SPSS (2010). *Statistical package for social sciences. Procedures and facilities for release*. Version 2.0 model of IBM. McGraw-Hill Book Co. New York, USA

Svihus B (2014). Function of the digestive system. *J Appl Poult Res* 23:306–314

Tugiyanti E, E Susanti (2022). Effect of various feed additives on carcass and meat quality of two different strains of chickens. *IOP Conf Ser: Earth Environ Sci* 1041:012076

USDA (1989). United States Department of Agriculture Poultry Grading Manual. Agriculture Handbook 31. Agricultural Marketing Service, USDA, Washington DC, USA

Zhang AW, BD Lee, SK Lee, KM Lee, GH An, KB Song, CH Lee (2005). Effects of yeast (*Saccharomyces cerevisiae*) cell components on growth performance meat quality and ileal mucosa development of broiler chicks. *Poult Sci* 84:1015–1021