INTESTINAL CHARACTERISTICS OF BROILER CHICKENS IN RESPONSE TO YEAST-TREATED DIALIUM BARK SUPPLEMENTATION

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ABSTRACT
Intestinal characteristics of broiler chickens fed diets supplemented with incremental levels of yeast (Saccharomyces cerevisiae) treated dialium bark were investigated. One hundred and eighty (180), one-day-old chicks (Ross 308) were weighed and randomly distributed into three treatment groups designated 0 (T0), 0.5 (T0.5), or 1.0 (T1.0) g kg^{-1} feed, giving five replicates of 12 chicks. Intestinal samples for analysis were obtained from each replicate on the 56th of the experiment and the data obtained analysed statistically. Results show that no statistical differences were found in intestinal lengths and weights of broiler chickens on dietary yeast-treated Dialium bark supplementation. In contrast, broiler chickens on T0.5 and T1.0 diets had significantly improved histomorphology of the jejunum. In conclusion, results suggest that yeast-treated dialium bark supplementation at 0.5 and 1.0 g kg^{-1} feed improved histomorphological indices of the jejunum without any negative effects on the intestinal lengths and weights of broiler chickens.
Keywords: Broiler chickens, dialium bark, yeast, intestinal biometry, histomorphology

INTRODUCTION

High levels of production and efficient feed conversion are the needs of the modern broiler industry which to a certain extent could be achieved by the use of specific feed additives. One of such feed additive is the stem bark of *Dialium guineense* Willd (Black velvet tamarind) plant. *Dialium guineense* Willd is native to Africa (Akinpelu *et al*., 2011). Dialium bark is rich in ash, fibre, flavonoids, and total phenols (Ogbuewu *et al.* 2023). In addition, dialium bark contains anti-nutritional factors (ANFs) like tannins, cyanogenic glycosides, and trypsin inhibitors (Ogbuewu and Mbajiorgu, 2023). A recent experiment in our station (Ogbuewu and Mbajiorgu, 2023) revealed that supplementation of broiler diet with dialium bark at 0.5 g kg^{-1} feed improved growth indices. However, broilers offered dialium bark at 1.0 - 1.5 g kg^{-1} feed gained less weight. The reasons behind the poor productivity of broilers fed 1.0 and 1.5 g kg^{-1} feed dialium bark is not clear but could be linked to its high fibre content and the presence of ANFs, among other factors. The potential of yeast (*Saccharomyces cerevisiae*) to break down complex carbohydrates in tree bark to their monomers has been reported (Azrinnahar *et al*., 2021; Liza *et al*., 2022). It was hypothesized that treating dialium bark with yeast would result in a value-added end-product, with prebiotic and probiotic properties resulting in the enhancement of gut physiology of broiler chickens. Thus, this study tests the hypothesis that supplementation of yeast-treated dialium bark to broiler diets would improve intestinal biometry and histomorphological indices.

MATERIALS AND METHODS

This investigation was done at the Poultry Unit, Federal University of Technology Owerri (4º4′ and 6º3′N and 6º15′ and 8º15′E) Nigeria. Dialium stem bark was obtained from the Institution's Botanical Garden and processed into meals as described by Ogbuewu and Mbajiorgu (2023). The dried active baker's yeast used in this experiment was procured from a reputable Pharmaceutical store in Owerri, Imo State. Nigeria. Dialium bark meal used in the present feeding experiment was fortified with dried active yeast at a ratio of 10:1.

The trial used 180 day-old chicks (Ross 308 broiler) which were randomly allocated to 3 treatment groups (T0, T0.5, and T1.0.) of 60 chicks each. Each group was replicated five times with twelve birds per replicate. Chicks in the T0 group received a basal diet without yeast-treated dialium bark supplementation which served as the control treatment. Broiler chicks in T0.5 and T1.0 groups received basal diet supplemented with TS at 0.5 and 1.0 g kg^{-1} feed, respectively. All the birds had *ad libitum* access to clean water and feed throughout the feeding period. Basal diets (Table 1) were prepared to meet the nutritional requirements of Ross 308 broilers.

On the 56th day of the feeding experiment, five broilers (one bird per replicate) were randomly selected, deprived of ration overnight, and killed by cervical dislocation. Intestinal lengths and weights were determined. Thereafter, the proximal section of the jejunum was excised following standard procedures. The excised samples were flushed

with saline, fixed in 10% neutral buffered formalin for 24 h, and thereafter embedded in paraffin wax. The embedded samples were sectioned and stained with haematoxylin and eosin (H&E). Tissue sections (5 µm thick) were cut using a microtome and captured via a microscope fitted to a digital camera. Villus height (VH) and crypt depth (CD) were determined, whereas, the VH/CD ratio was determined by dividing the VH by the CD. The presence of intact lamina propria was the criterion for selection of villus. Statistical analyses were performed using SPSS for Windows Version 10. Differences between means were determined at $p<0.05$ using the Least Significant Difference (LSD) test.

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

Ingredients (g/kg)	Starter (d 1 – 28)	Finisher (d 29 – 56)
Maize	540	600
Soybean meal	300	250
Spent grain	20	10
Wheat offal	40	30
Bone meal	30	35
Oyster shell	10	15
Palm kernel cake	50	50
Salt	2.5	2.5
Lysine	2.5	2.5
Methionine	2.5	2.5
Premix[1]	2.5	2.5
Nutrient composition (g/kg)		
Crude protein	239.0	203.9
Metabolisable energy (Kcal/kg)	2823	2823
Crude fibre	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

[1]*Premix provided per kg of ration: vitamin D_3 - 100 i.u; vitamin C - 2.40 g, vitamin E – 8 g; vitamin K - 0.4 g; vitamin B_1- 0.3 g; vitamin B_2, 1.0 g; vitamin B_6 - 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.*

Results

The intestinal biometry of broiler chickens fed diets supplemented with yeast-treated dialium bark is shown in Table 2. The results show that the lengths and weights of duodenum, Jejunum, and ileum expressed as percentages of live weight were not statistically influenced by yeast-treated dialium bark supplementation levels. Table 3 shows the results of jejunal villus height (VH), crypt depth (CD), and VH/CD ratio in broilers fed diets supplemented with yeast-treated dialium bark. Villus height and VH/CD ratio were significantly higher ($p < 0.05$) in broilers in groups T0.5 and T1.0 compared to birds in the T0 group. Broilers in the T0 group had significantly higher CD ($p < 0.05$) than those in T0.5 and T1.0 groups.

Table 2. Intestinal weights and lengths of broiler chickens fed diets supplemented with yeast treated dialium bark

Parameters	Levels of yeast-treated dialium bark (g kg^{-1})			Mean	SD	SEM	P-value
	0	0.5	1.0				
LIW % LW	0.16	0.20	0.25	0.20	0.10	0.03	0.571
DW % LW	0.96	1.36	0.92	1.08	0.32	0.11	0.189
JW % LW	2.01	2.14	2.09	2.08	0.25	0.08	0.847
IW % LW	1.48	1.86	1.63	1.66	0.41	0.14	0.576
LLI (cm)	11.00	10.50	12.33	11.28	1.70	0.57	0.450
DL (cm)	38.17	40.00	41.00	39.72	1.99	0.66	0.224
JL (cm)	99.17	102.33	100.33	100.61	4.62	1.54	0.753
IL (cm)	98.00	103.00	110.67	103.89	8.16	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.

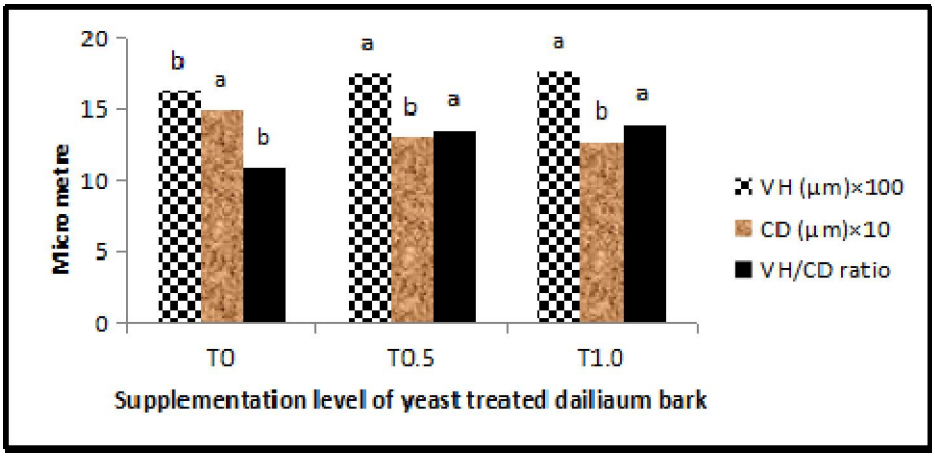

Figure 1. Histomorphology of the jejunum of broilers on yeast-treated dialium bark supplementation.
Bars not having the same superscript are significant ($p < 0.05$; LSD test). *VH* villus height; *CD* crypt depth;

Discussion

The chicken gut plays an important function in digestion and nutrient absorption. The results of this study show that weights of the large intestine and small intestine were numerically higher in broiler chickens fed a diet supplemented with yeast-treated dialium bark 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 lower than those recorded in indigenous Venda chickens (Mabelebele *et al*., 2014) and indigenous Buschveld chickens (Maoba *et al*. 2021). This variation is to be expected given that broiler chickens have been bred to reach market weight in a short period (Ogbuewu and Mbajiorgu, 2023). The increased lengths of duodenum, jejunum, and ileum in broiler chickens at 0.5 to 1.0 g/kg diet might be related to gastrointestinal tract adaptability to yeast-treated dialium bark-based diets. Although the ileal length is approximately the same as the jejunal length in the present study, 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 yeast treated dialium bark did not have adverse effects on the intestinal biometry of broilers.

The digestive tract is an intricate and constantly changing organ that plays an important part in feed digestion, nutrient uptake, and immune function (Lan *et al*., 2005). The use of gut histomorphological indices in pathophysiology and nutritional studies has been documented (Awad *et al*., 2009; Beski and Iji, 2015). Yeast-treated dialium bark increased jejunal VH, suggesting increased villus absorptive capacity. Reduced jejunal CD and increased VH/CD ratio as observed in broilers fed diets supplemented with yeast-treated dialium bark at 0.5 and 1.0 g kg^{-1} feed suggests enhanced ability for nutrient absorption. The enhanced histomorphology of the jejunum in broilers fed yeast-treated dialium bark diets may be ascribed to the stimulatory action of the product. Yeast present in dialium bark-based diets may have improved the histoarchitecture of the jejunum, which supports the findings of other researchers (Ogbuewu *et al*., 2019; Seifi *et al*., 2020).

CONCLUSION

In conclusion, results suggest that yeast-treated dialium bark supplementation at 0.5 and 1.0 g kg^{-1} feed improved the histomorphological of the jejunum without any negative effects on the intestinal lengths and weights of broiler chickens.

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