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GROWTH PERFORMANCE AND INTERNAL ORGANS MORPHOLOGY OF BROILER CHICKENS FED KENAF SEED MEAL

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ABSTRACT

Kenaf seed meal is a potential feed ingredient in poultry nutrition but little is known about its utilization in broiler diets. This study was carried out to examine the organ weights and intestinal morphology of broilers fed kenaf seed meal in combination with soya bean meal. Two hundred and forty birds were allotted to five treatments replicated six times with eight birds per replicate. The proximate composition of kenaf seed meal was determined, the broilers weight and feed intake were monitored. At six weeks of age, two birds were sacrificed per replicate and vital organs were carefully collected and weighed. Also, the villi width, height and crypt depth were measured. The results of the study show that kenaf seed meal was rich in crude protein (28%), gross energy (3,929Kca/Kg) and crude fibre (3.6%). It was observed that duodenal villi were more influenced than the ileal villi. Hence, the test diet was seemingly more absorbed in the duodenum region than in the ileum, suggesting effective nutrients utilization if offered at safe level.

Keywords: Alternative feed, Kenaf seed meal, GIT, Soya bean meal, feed conversion ratio.

INTRODUCTION

Poultry birds are sources of animal protein for humans especially the meat-type like broilers that mature in about 42 to 60days. In order to achieve this growth rate, diets containing high energy and protein feed ingredients are required. Some of these ingredients are staples for humans are often in high demand resulting in competition between livestock. This contributes to high cost of poultry production. The scarcity and high cost of these conventional ingredients has necessitate the sourcing for alternative feedstuffs that are affordable and readily available (Idahor, 2013). Hence, the quest for soy bean replacement with kenaf seed meal. Kenaf belongs to the family *Malvaceae*, genus *hibiscus* and species *cannabinus* (H'ng *et al.*, 2009; Webber and Bledsoe, 2002). It is an herbaceous annual low-cost natural fibre with a deep penetrating taproot and it is believed to be native of India. The fruits are fleshy, producing seed capsules of 1cm long containing many seeds which are brown and wedge-shape of 5mm weighing about 25g.

The seeds have potential yield of 25% oil which has been described as first class cooking oil and for margarine production. The seed meal after oil extraction contains 35% crude protein and has been fed to broilers where growth rate and performance indices were similar to broilers feed soy bean meal (Maché, 2002; Rajashekher *et al.*, 1993). Kenaf seed meal probably contains anti-nutritive factors that could affect the intestinal morphology resulting in its low digestion and absorption in the gastrointestinal tract. According to Yamauchi *et al.* (1993), nutrient absorption in the gastrointestinal tract is more effective with increase in the size and height of the intestinal villi which are more numerous in the duodenum than in the ileum (Gartner and

Hiat, 1997). It has be reported that diet influence the morphology of the intestinal villi and in poultry, correlation between the morphology of the intestinal villi and feeding habits has been reported (Rubio *et al.,* 1989; Yu *et al.,* 1998; Barry, 1976). This study was aimed at examining the effects of kenaf seed meal on performance indices and intestinal morphology of broilers.

MATERIALS AND METHODS

Study location

The experiment was conducted at the Poultry Unit, Teaching and Research Farm, University of Ibadan> The study site is located on latitude 07° 201 N and longitude 03°501 E, and has a hot humid equatorial climate which can be divided into four distinct seasons namely: early rainy season (April–June), the late rainy season (July – September), the early dry season (October December) and the late dry season (January – March)

Experimental design

Kenaf seeds were obtained from the Institute of Agricultural Research and Training, Moor Plantation, Ibadan. The seeds were cleaned, ground and incorporated into the starter diets at 0.0kg, 4.0Kg, 8.0Kg, 12.0Kg and 16.0kg to replace soy bean meal at 0.0%, 10.0%, 20.0%, 30.0% and 40.0% respectively. During the finisher phase, the level of kenaf seed meal inclusion in the diet reduced to 0.0Kg, 3.5kg, 7.0Kg, 10.5kg and 14.0kg at the same replacement value of 0.0%, 10.0%, 20.0%, 30.0% and 40.0% for soy bean meal respectively. Each diet represented the experimental treatments and were designated D1, D2, D3, D4 and D5 respectively The experimental starter and finisher diets are presented in Tables 1 and 2 respectively. The proximate analysis of the diets was done according to the procedure of AOAC (2012).

Table 1: Gross Composition of the Starter Diets

	DIETS				
Ingredients	**D1**	**D2**	**D3**	**D4**	**D5**
Maize	53.25	53.65	54.05	54.15	53.65
Soy bean meal	40.00	36.00	32.00	28.00	24.00
Kenaf seed meal	0.00	4.00	8.00	12.00	16.00
Fish meal	0.00	0.50	1.10	2.00	3.00
Di-calcium phosphate	1.50	1.50	1.50	1.50	1.50
Lime stone	1.00	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.25	0.25	0.25	0.25	0.25
Soy oil	3.40	2.50	1.50	0.50	0.00
Total	100.00	100.00	100.00	100.00	100.00
Determined values					
Gross energy (kcal/kg)	3005.12	3009.53	3007.90	3004.77	3028.80
Crude protein (%)	23.45	23.22	23.05	23.07	23.10

Proximate composition of kenaf seed: Crude protein (28.01%); Crude fibre (3.59%); Ether extract (14.38%); Energy (3,929 kcal/kg); Calcium (1.65%); Total phosphorus (0.37 %).

Table 2: Gross Composition of the Finisher Diets

Parameters	D1	D2	D3	D4	D5
			DIETS		
Maize	57.65	56.65	56.65	56.65	56.65
Soy bean meal	35.00	31.50	28.00	24.50	21.00
Kenaf seed meal	0.00	3.50	7.00	10.50	14.00
Fish meal	1.00	2.00	3.00	3.00	4.00
Di-calcium phosphate	1.50	1.50	1.50	1.50	1.50
Limestone	1.00	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.25	0.25	0.25	0.25	0.25
Soy oil	3.00	3.00	2.00	2.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Determined values					
Gross energy (kcal/kg)	3012.47	3057.14	3046.41	3096.08	3085.35
Crude protein (%)	22.46	22.51	22.67	22.11	22.27

Proximate composition of kenaf seed: Crude protein (28.01%); Crude fibre (3.59%); Ether extract (14.38%); Energy (3,929 kcal/kg); Calcium (1.65%); Total phosphorus (0.37 %).

Experimental birds and management

Two hundred and forty broilers (Arbor acre strain) were obtained from Ibadan and were allocated to the five experimental diets. The birds were fed the experimental diets and offered drinking water *ad libitum* for six weeks. The pens, feed and water troughs were cleaned regularly and the vaccination schedule was strictly followed.

Parameter measured

The birds were at the beginning of the study to get the initial weight and subsequently weekly using table scale before feeding. At the end of the experiment, six birds per replicate were randomly selected, fasted overnight and sacrificed by severing the jugular vein. The dressed carcasses were eviscerated and the liver, heart, abdominal fat, gizzard and spleen were carefully obtained and weighed using sensitive weighing balance and the values were expressed in relative body weight. The duodenum and ileum segments of the gastrointestinal tract were carefully cut and processed for histo-morphometry as described by Iji *et al.* (2001). The villi width and height were measured under microscope (Olympus Corporation, Tokyo, Japan) using image-analysis software. In each case, data were collected twice and the average values were recorded. The dressed weight, drumstick and breast values were expressed as percentage of the carcass weight.

Data Analysis

All the data collected were analyzed using SAS (1998) and were applicable, the mean values were separated using Duncan multiple Range Test (SAS, 1998) the same software package.

RESULTS

The initial and final body weights of broilers fed kenaf seed meal and organs weight are presented in Table 3. There were no statistical differences (P>0.05) in all the parameters measured across the treatment except for final body weight. The birds in control diet (DI) were significantly (P<0.05) heavier (1,136.05g), slightly follow by birds in D3 903g whereas, birds in D2 and D5 did not differ from each other but were statistically higher ($P<0.05$) than 667g recorded in D4.

Liver weight values varied between 2.4g in birds fed the control diet and 2.93g in D4, heart (0.5 and 0.65g), abdominal fat (0.5 and 1.18g), gizzard (0.041 and 0.044g) while spleen values were between 0.001 and 0.0018g.

Table 3: Effects of Kenaf Seed Meal on Performance and Organs Weight of Broilers

			Diets			
Parameters	**D1**	**D2**	**D3**	**D4**	**D5**	**SEM**
Performance						
Initial body weight (g)	39.00	37.90	38.70	39.10	38.70	0.22
Final body weight (g)	1136.50^{a}	755.30^{bc}	903.00^{b}	667.00^{c}	843.90^{bc}	42.60
Relative organ weight						
Liver (g/kg BW)	2.40	2.41	2.38	2.93	2.60	0.09
Heart (g/kg BW)	0.50	0.63	0.58	0.65	0.60	0.02
Abdominal fat (g/kg BW)	0.50	0.56	1.18	0.60	0.65	0.10
Gizzard (g/kg BW)	0.042	0.041	0.041	0.044	0.042	0.001
Spleen (g/kg BW)	0.0015	0.0017	0.0010	0.0018	0.0017	0.0002

^{a,b}: Mean values on the same row with different superscript differ significantly at 5% probability; SEM: Standard error of mean; BW: Body weight.

Expressed in Table 4 is the intestinal morphology of broilers fed kenaf seed meal. There were no statistical differences ($P<0.05$) in all the parameters measured across the treatments except, ileal villi height and crypt depth values that were statistically higher ($P<0.05$) in birds on D1 and values were 830µcm and 962.5µcm respectively. While ileal villi was least in D4 (541.1µcm), crypt depth value did not differ significantly ($P<0.05$) among the birds in D2, D3 and D4 but was significantly lower ($P<0.05$) in D5 with 610.2µcm.

The duodenal villi width value ranged from 137.2µm to 221.7µm, villi height (667.6µm to 857.6µm) and the crypt depth value varied between 263.7µm (D4) and 373.9µm in control diet (D1).

Table 4: Intestinal Morphology of Broilers Fed Kenaf Seed Meal

	Diets					
Parameters	**D1**	**D2**	**D3**	**D4**	**D5**	**SEM**
Duodenum						
Villus width (μm)	154.8	217.7	221.7	142.7	137.2	11.1
Villus height (μm)	741.7	857.6	667.6	776.7	722.2	35.1
Crypt depth (μm)	373.9	266.6	354.6	263.7	271.3	20.9
Villus: crypt ratio	2.82	3.26	1.98	3.06	2.74	0.21
Ileum						
Villus width (μm)	150.8	143.9	153.8	153.4	146.2	5.53
Villus height (μm)	830.0^{a}	664.1^{b}	537.8^{c}	541.1^{c}	604.6^{bc}	24.9
Crypt depth (μm)	962.5^{a}	762.8^{ab}	845.4^{ab}	804.3^{ab}	610.2^{b}	53.3
Villus: crypt ratio	1.04	1.03	0.68	0.71	1.14	0.08

^{a,b}: Mean values on the same row with different superscript differ significantly at 5% probability; SEM: Standard error of mean

DISCUSSION

The proximate analysis indicated that kenaf seed meal protein value was higher than 21.4% (Webber CL and Bledsoe VK. 2002) and 27.2 (Feedipedia, 2016) reported in kenaf seeds. These observations were similar to the values of 38.5 to 39.4% (Iheukwumere *et al.*, 2008) and 36 to 44% (Olomu, 2011) reported in soy bean meal. Thus, kenaf seed meal may probably replace soy bean meal in broiler nutrition with little or no detrimental effects (Maché 2012; Rajashekhar *et al.*, 1993). Meanwhile, the body weights of the broilers were tremendously depressed by kenaf seed meal. Yet, the dressing percentage was similar to 64.8 to 71.1% reported by Idahor (2012) when cassava peel was fed to broilers and lower than 81 to 85.4% observed when tallow seed meal was fed (Obun *et al.*, 2008). The liver, heart, gizzard and spleen weight values were much less than the reported values by Adeyemo (2014) when African porridge fruit was fed to broilers. However, Adeyemo *et al.* (2015) reported feed conversion ratio values of 2.03 to 2.16 when varying energy and protein levels were monitored in broilers which were greater than the observed values in the present study. Meanwhile, the observed value was superior in control diets, probably due to the quality of nutrients in soy bean meal that may not be available in kenaf seed meal. Since the relative organs weight values were seemingly not influenced by the inclusion of kenaf seed meal, kenaf seed meal may replace soy bean meal in broiler diet. Nevertheless, the liver weight was lower than 57.1 to 97.0g reported by Idahor (2012) and Obun *et al.* (2008). This may be due to broiler age disparities or a suggestion of hepatotocity potential of kenaf seed meal. The heart weight was similar to 6.0 to 6.8g but the gizzard weight was more than 33.5 to 36.5g reported by Idahor (2012). The level of abdominal fat accumulated in the broilers, indicated that lean poultry meat production may be achievable when kenaf seed meal is fed to broilers.

Although, the performance indices measured were not linear, all the values where somewhat within the range of values reported for healthy poultry birds Hassan and Hassan, 2003; Margi, 1997). Consequently, kenaf seed meal may be included in broiler diets with little or no detrimental effects as reported by Maché (2012) and Rajashekher *et al.,* (1993). It was observed that the duodenal villi width, height and crypt depth were somewhat increased in the treated birds compared to those in the control diet. This probably suggested that kenaf seed meal inclusion in broiler diet may enhance effective nutrient absorption in the duodenum region of the gastrointestinal tract as envisaged by Yamauchi *et al.* (1993). This seemed apparently correct, minding the speculation of Gartner and Hiat (1997) that the duodenal villi width, height and crypt depth in the treated birds were inferior compared to the birds in control diets. This probably buttressed the possibility of more nutrient absorption in the duodenum than in the ileum. Kenaf seed meal apparently influenced the intestinal morphology thus, lent more credence to the correlation reported between intestinal villi morphology and poultry feeding habits (Rubio et al., 1989; Yu *et al.*, 1998; Barry, 1976). Therefore kenaf seed meal may boost intestinal villi functions for efficient nutrients utilization.

CONCLUSION

It was shown that kenaf seed meal has sufficient nutrient required by broilers thus, could replace soya bean meal in order to reduce cost of production. The test diet drastically depressed the broiler growth rate and feed conversion ratio thus, may not be suitable as replacement ingredient broiler diets. The intestinal morphology of the broilers was apparently influenced by the test diet thus, may enhance intestinal villi functions for proficient broiler production, if fed at safe inclusion level.

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