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Growth Responses of Finisher Broiler Chickens Fed with an Unconventional Feedstuff Toasted *Adenanthera pavonina* Seed Meal as a Partial Replacement of Soybean Seed Meal

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ABSTRACT

The effect of graded levels of toasted *Adenanthera pavonina* seed meal (TAPSM) on the performance, carcass and organ characteristics of finisher broiler chickens was investigated in a five-week feeding trial with 84 (5-week old) broilers divided into four groups of 21 birds per group with three replicates of 7 birds. Four experimental diets were formulated to contain 0, 10, 20, and 30% toasted *Adenanthera pavonina* seed meal (TAPSM), represented as T1, T2, T3, and T4, respectively. Birds were allocated to the diets in a completely randomized design and housed in a deep litter pen with feed and water offered ad libitum. Average daily weight gain (70.00, 72.53, 61.78 and 55.33 g), daily feed intake (170.79, 174.00, 136.00 and 100.00 g) and feed conversion ratio (2.39, 2.39, 2.20 and 1.81) decreased significantly (P<0.05) as the level of TAPSM increased in the diets. Dressing percent (92.37, 90.47, 89.60 and 80.56 %), breast (26.67, 22.81, 19.46 and 15.59 %), wings (10.27, 10.11, 8.15 and 7.67 %), drumstick (13.02, 12.33, 11.25 and 9.10 %), back (14.81, 13.37, 13.14 and 11.29 %) and neck (2.49, 2.11, 2.03 and 1.89 %) decreased significantly (P<0.05) among treatment groups. Liver (2.08, 2.42, 2.88 and 2.94 %), heart (1.09, 1.00, 1.12 and 1.58 %), kidney (1.64, 1.67, 1.86 and 1.88 %), spleen (0.31, 0.31, 0.98 and 1.20 %) and gizzard (2.24, 2.21, 2.62 and 2.63 %) weights increased as the level of TAPSM in the diets increased, indicating that incorporating this novel feedstuff in finisher broiler diets at levels above 10% could reduce growth performance and decrease productivity, it is also noted that this feedstuff could contain some anti nutritional elements that require more processing techniques to get to a minimal level other than toasting as evidenced in the increasing weight of the visceral organs such as the liver as the level of TAPSM increased in the diet. Therefore, this unconventional feedstuff should be used with caution in broiler finisher diets and should not exceed a 10% level of inclusion, otherwise would impair growth performance and carcass yield.

INTRODUCTION

The poultry industry as one of the most profitable business of agriculture provides nutritious meat and eggs for human consumption within the shortest period. However, availability of quality feed at a reasonable cost is a key to successful poultry business (Basak et al., 2002). The high cost of feed in the livestock industry is because of high costs of some conventional feed ingredients that man competes for with animals. It is also an established fact that feed accounts for about 70-80% of the production costs (Nworgu et al., 2007).The decline in poultry industry and its consequences on the sub-optimal protein consumption by Nigerians is a dangerous signal to imminent animal protein mal-nutrition. Fifty per cent of Nigeria's poultry farms have closed down and another 30% forced to reduce their production capacity because of shortage of feed (Esonu et al., 2001).The possible solution to these feed problems may be by adopting the use of lesser known and abandoned tropical legumes, by-products of agricultural wastes and other wastes from the farm which can be processed and packaged for incorporation into poultry rations (Dafwang and Shwarmen, 1999;Dafwang, 2006), as this will result in cheaper feed, reduced costs of meat and eggs and reduced cost of production. Some of the recently investigated unconventional feed ingredient sources for poultry and pig production include, *Mucuna* seed meal (Iyayi et al., 2006), *Napoleona* seed meal (Uchegbu et al., 2004; Urom et al., 2018), *Cyperus Esculentus* (Ukpabi, et al., 2019), toasted seeds of *Adenanthera pavonina* (Ukpabi, et al., 2018), raw seeds of *Adenanthera pavonina* (Ukpabi, et al., 2017)*, Azolla pinnata* (Alalade and Iyayi, 2006) and neem leaf meal (Olowu et al., 2013). *Adenanthera pavonina* seed contains appreciable amounts of protein 29.44g/100g, crude fat 17.99g/100g and minerals comparable to commonly consumed staples (Ezeagu et al., 2004), and we proposed that it would be a good and cheaper source of protein in broiler finisher diet relative to soyabean meal. This work was designed to evaluate the effect of toasted *Adenanthera pavonina* seed meal (TAPSM) based diet on growth performance, carcass, and organ characteristics of finisher broiler chickens.

MATERIALS AND METHODS

(a) Experimental site

The experiment was carried out at the Livestock Unit of Faculty of Agriculture Teaching and Research Farms, Abia State University, Umudike Campus. Umudike is located on longitude 7°31¹ East and latitude 5°28¹ North, at an attitude of 122meters above sea level (Adiele et al., 2005).

(b) Procurement of feed ingredients

Adenanthera pavonina seeds were gathered from the University premises in Umudike, Abia State and National Institute for Horticulture (NIHORT) Mbato in Okigwe, Imo State. Other feed ingredients were purchased from a commercial feed shop in Umuahia, Abia state.

(c) Processing of *Adenanthera pavonina* seeds

The raw seeds were sorted, toasted for 15mins at a temperature range of 60 - 65°C, the timing started immediately the seeds were poured into the toaster. The seeds were cooled before being milled with a hammer mill. The toasted APSM was then weighed according to formulation standard before mixing it with other feedstuffs in the diet.

(d) Experimental design

A total of eighty-four, 5 weeks old Anak broilers were used for the experiment. The birds were divided into four groups of twenty-one birds each and assigned to four treatment diets in a completely randomized design (CRD). Each group was further sub-divided into three replicates of seven birds each. Feed and water were offered *ad libitum* and the feeding trial lasted 5 weeks.

(e) Experimental diets

Four experimental diets were formulated by incorporating TAPSM at 0, 10, 20 and 30% dietary levels for T_1, T_2, T_3 and T_4, respectively. The composition of the experimental diets is shown in Table 1.

Table 1. Composition of experimental diets (%)

	TAPSM Inclusion Levels in Diets (%)			
Ingredients	T_1 (0)	T_2 (10)	T_3 (20)	T_4 (30)
Maize	50.00	45.00	40.00	35.00
Soya bean meal	25.00	20.00	15.00	10.00
TAPSM	0.00	10.00	20.00	30.00
Blood meal	2.00	2.00	2.00	2.00
Palm kernel cake	14.00	14.00	14.00	14.00
Fish meal	4.00	4.00	4.00	4.00
Palm oil	1.00	1.00	1.00	1.00
Bone meal	3.00	3.00	3.00	3.00
Premix*	0.30	0.30	0.30	0.30
Salt	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Composition				
Crude protein (%)	23.03	23.37	21.71	21.05
ME (MJ/kg)	12.43	12.02	11.61	11.19

*Vitamin mineral premix provides per kg diet: vit. A, 13.340 iu, vit D_3 2680 iu, vit E10 iu, vit. K, 2.68 iu, Calcium pantothenate, 10.68mg, vit. B_{12} 0.022 mg; Folic acid, 0.668 mg; Choline Chloride 400mg; Chlorotetracycline, 26-28mg; Manganese, 133.34mg; Iron, 66.68mg; Zinc, 53.34mg Copper, 3.2mg; Iodine, 1.86mg; Cobalt, 0.268mg; Selenium, 0.108 mg. ME= Metabolizable Energy (MJ/kg), calculated according to Pauzenga (1985) as ME (MJ/kg) = 37 × % CP + 81 × % EE + 35.5 × % NFE (Folorunso et al., 2016); TAPSM = Toasted *Adenanthera pavonina* seed meal.

(f) Sample collection

The birds were weighed at the beginning of the experiment to obtain their initial body weights and then weekly, thereafter. Daily feed intake was determined by subtracting the weight of left-over feed from the weight of the feed fed the previous day. Data collected included initial and final body weights, average daily feed intake, and daily weight gain and feed conversion ratio.

(g) Chemical analysis

Proximate composition of the experimental diets and toasted *A. pavonina* were determined by the procedure described by the Association of Analytical Chemists (AOAC, 2006) and presented in Table 2.

Table 2. Determined proximate composition of experimental diets and toasted *Adenanthera pavonina* (L) seed meal (TAPSM)

	TAPSM Inclusion Levels in the Diets (%)				
Parameter	T_1 (0)	T_2 (10)	T_3 (20)	T_4 (30)	TAPSM
Dry matter	94.16	94.18	94.20	94.20	92.00
Crude protein	21.05	20.04	20.02	20.00	20.08
Crude fibre	11.00	11.16	13.04	15.00	14.00
Ether extract	9.12	8.66	8.65	8.16	9.04
Ash	9.52	9.04	8.56	8.51	3.10
NFE	43.47	45.28	44.16	42.92	45.78
ME (MJ/kg) *	12.84	12.79	12.77	12.84	13.00

TAPSM = Toasted *Adenanthera pavonina* seed meal; NFE Nitrogen-free extracts; *ME = Metabolizable energy, calculated according to Pauzenga (1985) as ME (MJ/kg) = 37 × % CP + 81 × % EE + 35.5 × % NFE (Folorunso et al., 2016)

(h) Carcass Evaluation

At the end of the experiment, nine birds were randomly selected from each treatment (3 per replicate) and used for evaluation of carcass and internal organ weights. They were starved of feed for 12 hours, weighed and euthanized. They were defeathered, using hot water (below 72^{o}C) and separated into head, neck, feet, and visceral organs. The wings were removed by cutting anteriorly severing at the humero-scapular joint. The cuts were made through the rib head intact by pulling anteriorly. Thighs and drumstick were dissected from each carcass and weighed separately.

(i) Data analysis

Data obtained were subjected to statistical analysis using one-way analysis of variance (ANOVA) as outlined in Steel and Torie (1980). Duncan's multiple range test was used to separate significant treatment means where they occurred (Obi, 1990).

RESULTS AND DISCUSSION

Growth Performance

The results of growth performance of finisher broiler fed varying levels of toasted *Adenanthera pavonina* seed meal (TAPSM) are presented in Table 3. For all the growth parameters measured, there were significant ($p<0.05$) differences except in initial body weight. The daily weight gain, feed intake and feed conversion ratio declined with an increase in the level of TAPSM in the diets. This result agreed with the findings of Amaefula and Obioha (2001), who reported that pigeon pea-based diets become less palatable as the level of inclusion increased beyond 40%. This may explain the observed depression in feed intake of birds in 20% and 30% TAPSM based diets. The daily weight gain ranged from 72.00g in T_1 to 55.33g in T_4. The weight gains between birds fed T_1 and T_2 diets were similar but differed significantly ($p<0.05$) from birds fed T_3 and T_4 diets, respectively. The poor weight gain observed in birds fed 20% and 30% TAPSM based diets may be partly due to low feed intake (Amaefula et al., 2003) as well as poor nutrient utilization possibly due to the effect of residual anti-nutritional factors present in most processed legume seeds (Seotan and Oyewole, 2009). Feed conversion ratio followed the same trend, it decreased with an increase in the level of TAPSM in the diet. Birds fed control diet (0%) and (10%) TAPSM based diet had the highest FCR, while birds fed 30% TAPSM based diet had the lowest and better FCR. The observed feed conversion ratio in birds fed 0% and 10% diets could be attributed to poor feed utilization. (Bot et al., 2013). No mortality was recorded in all the treatments, thus indicating that TAPSM had no deleterious effect on finisher broiler chickens. The obtained results were in line with earlier reports by (Oyawoye et al., 1999; Iheukwumere et al., 2002; Akinmutimi and Okwu, 2006).

Table 3: Performance of finisher broilers fed graded levels of toasted *Adenanthera pavonina* seed meal

	Level of Inclusion of TAPSM (%)				
Parameter	T_1 (0)	T_2 (10)	T_3 (20)	T_4 (30)	SEM
Initial body weight (g)	556.67	573.33	560.00	566.67	16.58
Final body weight (g)	1660.00^{a}	1656.67^{a}	1506.67^{ab}	1200.00^{b}	56.62
Ave. Daily weight gain (g)	72.00^{a}	72.53^{a}	61.78^{b}	55.33^{c}	0.58
Ave. Daily feed intake (g)	170.79^{a}	174.00^{b}	136.00^{c}	100.00^{d}	0.58
FCR	2.39^{a}	2.39^{a}	2.20^{b}	1.81^{c}	0.09

$^{a\,b\,c\,d}$ Means in the same row with different superscripts differed significantly ($p<0.05$).
TAPSM - Toasted *Adenanthera pavonina* seed meal; FCR-Feed conversion ratio; SEM-Standard error of the means.

Carcass characteristics

The results of carcass characteristics of finisher broilers fed varying levels of TAPSM are presented in Table 4. There were significant ($p<0.05$) differences among the treatment means in all the parameters measured. Since carcass yield is an indication of the quality and utilization of the ration (Bamgbose and Niba, 1998). Birds on diet 4 (30% TAPSM) poorly utilized their feed as evidenced by their significantly ($p<0.05$) low breast muscle yield, thigh, wings, back, neck and drumstick. Carcass parameters decreased as the level of TAPSM increased in the diet, with the control diet (T1) having the highest values followed by treatment 2 diet (10% TAPSM) which compared favourably with the control diet (0% TAPSM). The decrease in carcass parameters across the dietary treatments could be as a result of different abilities of the test diet to induce tissue lay down for a particular cut part (Abiola, 1999) suggesting treatment 2 diet (10% TAPSM) as an alternate diet for carcass parameters. Similarly, increasing the content of TAPSM in the diet from 0 to 30% will result in corresponding increases in the residual anti nutrient which will impact negatively on the nutrient utilization. This corresponded with the observation of Onimisi (2005), who observed decreased values of live weight, carcass weight and dressing percentage between the treatments as the level of ginger waste meal increased in the diets of broiler chickens.

Table 4: Cut Parts of Finisher Broiler Chickens Expressed as Percentage of Dressed Weight

	Level of Inclusion of TAPSM				
Parameter	T_1 (0)	T_2 (10)	T_3 (20)	T_4(30)	SEM
Live weight (g)	1660.00^{a}	1656.67^{a}	1506.67^{a}	1200.00^{b}	56.62
Dressed weight(g)	1533.33^{a}	1500.00^{ab}	1350.00^{b}	966.67^{c}	20.41
Dressing (%)	92.37^{a}	90.47^{b}	89.60^{c}	80.56^{d}	0.58
Breast muscle (%)	26.67^{a}	22.81^{a}	19.46^{bc}	15.59^{c}	1.88
Thigh (%)	13.62^{a}	13.37^{a}	11.86^{ab}	10.53^{b}	0.66
Wings (%)	10.27^{a}	10.11^{a}	8.15^{b}	7.67^{b}	1.39
Drumstick (%)	13.02^{a}	12.33^{a}	11.25^{a}	9.10^{b}	0.82
Back (%)	14.81^{a}	13.37^{ab}	13.14^{ab}	11.29^{b}	1.08
Neck (%)	2.49^{a}	2.11^{ab}	2.03^{b}	1.89^{b}	0.39

$^{a\,b\,c\,d}$ Means in the same row with different superscripts differed significantly ($p<0.05$).
TAPSM - Toasted *Adenanthera pavonina* seed meal; SEM-Standard error of the means.

Organ characteristics

The organ characteristics values are presented in Table 5. There were significant ($p< 0.05$) differences in the organ parameters measured. Organ weight increased with increased levels of TAPSM. The higher values observed with heart, liver, and kidney of birds on 30% inclusion diet may suggest increased physiological activities by these organs triggered by the presence of residual anti-nutritional factors and their concomitant effects. The high value of heart in T_4 (30% TAPSM) could be attributed to the effect of higher concentration of anti-nutrients leading to excess work load with an accompanying increase in the mass of myocardial fibre and hence increase in weight of the heart (Radiostis et al., 1997).

The highest value (1.88) for kidney was observed in birds fed 30% TAPSM, this could be because of the increase in the activity of the kidney enzymes to detoxify and excrete most toxic materials from the body (Jubb et al., 1995). The increase in the weight of spleen in T_4 (30% TAPSM) could be associated with deficiencies of both energy and protein, which may be due to inhibitions by the anti-nutritional factors (Olomu, 2010), various literatures have reported that most underutilized legumes of which *Adenanthera pavonina* is one of them contain some anti nutrients which could hinder their utilization and absorption by the broiler chicks, this study could say that 15mins toasting of APSM at 60-65^{0}C did not reduce some of these anti nutrients in the seed of this test feed ingredient at a minimal level as evidenced in the reduced growth and carcass yield of broiler chicks used in this study. Therefore, there is need to explore various processing strategies in other to make the best use of this unconventional feed stuff in broiler nutrition.

The results obtained in this study indicated that finisher broilers could tolerate 10% TAPSM inclusion level in the diet without much negative effect on the performance, carcass characteristics and organ weights.

Table 5: Organ Weight Expressed as Percentage Dressed Weight of Broiler Chickens Fed Graded Levels of Toasted *Adenanthera Pavonina* Seed Meal.

	Level of Inclusion of TAPSM (%)				
Organ (%)	T1 (0)	T2 (10)	T3 (20)	T3 (30)	SEM
Liver	2.08^{b}	2.42^{ab}	2.88^{a}	2.94^{a}	0.30
Heart	1.09^{b}	1.00^{b}	1.12^{a}	1.58^{a}	0.16
Kidney	1.64^{b}	1.67^{b}	1.86^{a}	1.88^{a}	0.25
Spleen	0.31^{c}	0.31^{c}	0.98^{b}	1.20^{a}	0.10
Gizzard	2.29^{b}	2.27^{b}	2.62^{a}	2.63^{a}	0.40

$^{a\ b\ c\ d}$ Means in the same row with different superscripts differed significantly ($p<0.05$). TAPSM - Toasted *Adenanthera pavonina* seed meal. SEM Standard error of the means

CONCLUSION

From this study, it was observed that growth and carcass parameters reduced with increasing levels of toasted *Adenanthera pavonina* seed meal in the diets at 20 and 30%, while the organ parameters increased with increasing levels of TAPSM in the diet.

The use of this unconventional feedstuff should be with caution in the diet of finisher broilers and our result may suggest a 10% inclusion level of toasted *Adenanthera pavonina* seed meal in finisher broilers' ration without any adverse effect on performance, carcass and organ characteristics as the birds in the 10%TAPSM group competed favorably with the birds in the control diet 0%TAPSM group.

Further study is needed to explore and compare other processing methods on the seed of *Adenanthera pavonina* and their effects on finisher broilers' growth development and digestibility.

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