Effects of Fungal Degraded Cob Product Supplementation on Broiler Chicks' Diet: Performance and Histopathological Characteristics

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Abstract—*Agricultural waste which had been used in solid state fermentation for feed production include maize cob which has a large cellulose and hemicellulose reserve. Large scale fungal degradation of maize cob was carried out and the product, fungal degraded cob product (FDCP) was used to supplement broiler finisher diet at different concentrations. Significant differences were observed in the weight gain, feed efficiency and feed conversion ratio. The mean daily weight gain was higher in D2 birds (18% FDCP) the D1 (commercial feed) and other diets. The lungs and pancreas of all birds did not show any disease symptoms. However, the liver of birds fed diet 3 (50% FDCP) showed necrotic lesion while the kidney of diet 4 birds showed interstitial congestion and hemorrhage. It is concluded that low level of supplementation of FDCP up to 18% is advantageous to the bird.*

Keyword—broiler diet; feed efficiency; fungal degradation; histopathology; maize cob,

1 INTRODUCTION

The unprecedented increase and prohibitive cost of conventional ingredients used in compounding livestock feed has necessitated intensive investigations into the use of agricultural and agro-based industrial by-products (Adeyemi and Familade, 2003). Agricultural waste include maize cob, a major cereal by-product worldwide mostly prominent in Nigeria and their use as ruminants feed stuff has been reported (Alokan, 1988, Babayemi*et al.*, 2009., Jansen, 2012 and Kanengori*et al.*, 2015). Maize cob is widely available in large quantity in Nigeria produced approximately 1.5million tonnes during the 2009 to 2010 season. It could be cheaply procured but it has the disadvantage of poor nutritional value (Dzowela, 1987, FAO, 2012, Jansen, 2012). Poultry, however, cannot access the nutrient in maize cob because their enzymatic digestion cannot properly breakdown the cellulose cell wall hence, the use of fermentation techniques (Dirar, 1992).

In agro-based industry, solid state fermentation has been applied in the process of transformation of food residues for the production of traditional fermented food, protein enrichment and single-cell protein production (updegraff 1971). The filamentous fungi are the best adapted microorganism for solid subtrate fermentation owing to their physiological, enzymological and biochemical properties. Their ability to grow at low water activity and high osmotic pressure conditions makes fungi efficient and competitive in natural microflora, for bioconversion of solid substrate (Faniyi, 2006). Fermentation generally reduced crude fibre content in crop residues especially when fermented with fungi (Belawu, 2003) and increase crude protein (Oduguwa, 2008).

However, the substantive effect of feeds compounded from such fermentation product on the chicken need to be determined. Onilude and Oso (1999b) reports that enzyme supplementation of various fibres had significant effect on the total lipid of the blood, liver and kidney of the birds relative to their age and type of fibre. However not much has been reported in the pathological effect of such feed supplement in major organs of the birds. This study therefore aims at investigating the effect of replacement of maize at different percentages with fungal degraded maize cob in the broiler diet, on the performance characteristic and the liver, pancreas, kidney and lungs of fed chicken.

2.0 MATERIALS AND METHOD

2.1 Organism and Cultural Conditions

The organism, *Aspergilllusniger* utilized in this study was isolated from degrading maize cob. Isolation was made by using both pour plate and spread place method of Olutiola*et al*., (1999). Pure culture of the bacteria was routinely maintained on potato dextrose agar slant.

2.2 Fermentation of Maize cob

2.2.1 Preparation of Inoculum for FDCP Production

Large quantities of maize cobs were sun dried to make them more friable for crushing by using laboratory hammermill. The crushed substrate was then sieved to get the required substrate size (1mm). Distilled water was added in ratio 1:2 substrate; water and chicken extract solution. Sterilization was done at 121^0Cfor 15 minutes. On cooling, it was inoculated and left to ferment at 30^0C for 28 days.

2.2.2 Scale up of Feed Production

Large scale production of FDCP was done by using a fabricated silo prepared from used cylindrical steel drum (60cm diameter and 110cm height). The inner portion of the silo was lined with 0.25mm polyethylene for each experimental bag in which fungal inoculum was used. Twenty four (24) kg of corn cob containing other additive was sterilized in a giant autoclave and loaded into polythene bag, inoculated with inoculum and then sealed up after which it was covered with metallic lid. Fermentation was allowed to take place for 28 days at room temperature. The product is the Fungal Degraded Cob Product.

2.3 Experimental Diets

Four dietary feeds containing basal diets were prepared in which FDCP was substituted for maize at 18, 50 and 82% while the commercial fed served as the control (Table 1). The experimental diets and clean drinking water were provided ad libitum throughout the experimental period. Conventional management practices were observed in all the seven treatments.

2.4 Experimental Birds

Four weeks old 40 broiler chicken (abroacha breed) were used in the study. They were individually weighed and randomly assigned to four treatments (diets) in groups of 10 birds per treatment. The treatments were replicated two times with 5 birds per replicate. The birds were maintained on the diets for six weeks.

2.5 Performance Characteristics

The feed intake, feed conversion ratio, feed efficiency, body weight and body weight gain of the experimental birds were determined on weekly basis for the period of six weeks. The daily feed intake was obtained by subtracting the left-over from the total amount of feed supplied. Birds in each group were weighed at the inception of the experiment and weekly thereafter to obtain the weekly and daily weight.

2.6 Histological Procedure

Histological processing (preparation of organs and tissues for macroscopic examination of the excised tissues of the lungs, liver, kidney and pancreas from the sacrificed broiler chicks of all the diets were performed using medical laboratory technology and clinical pathology (MLTCP) and MPAMA's procedure (Baker and Silvertons, 1985).

2.7 Analysis of Data

All the data obtained from the study were analyzed with SAS and SPSS, a computer software package to determine ANOVA and the test of significance were carried out using Duncan's multiple range tests (Duncan, 1955).

Table 1: Composition of the Experimental Diets (Broiler Finisher)

	Diets (Kg/100kg)			
Ingredient %	**1**	**2**	**3**	**4**
Maize	54.00	44.00	27.00	10.00
Fungal Degraded Cob Product FDCP	-	10.00	27.00	44.00
Wheat offal	10.00	10.00	10.00	10.00
Groundnut cake	15.20	15.20	15.20	15.20
Soybean meal	12.50	12.50	12.50	12.50
Fish meal	5.00	5.00	5.00	5.00
Bone meal	2.50	2.50	2.50	2.50
Broiler premix	0.30	0.30	0.30	0.30
Salt (Nacl) 0.30	0.30	0.30	0.30	
Methionine	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**

3. RESULTS

The feed conversion ratio (FCR) for D4 was significantly higher (4.74) compared to 3.60, 2.97 and 3.96 found in D1, D2 and D3 respectively. Feed intake ranges from 4852g to 5190g in all the diets with the highest feed intake observed in D1 which is the commercial feed. Result of performance parameters are presented in Table 2. There were significant differences in the mean feed intake, body weight gain and mean daily weight gain of the experimental birds. The weight gained by D2 birds (18% FDCP) was higher (1635g) than in the control D1 (1440g) experimental D3 (1290g) and D4 (1058g). Feed utilizations was lowest in Diet 4 (82% FDCP) with the value of 0.21 compared to D1, D2, and D3 (0.28, 0.34 and 0.25) respectively. The histopathological examination of experimental birds revealed that no visible lesion in the pancreas in all diets (Table 3). The lungs showed mild congestion and generalized congestion in D1 and D2 birds respectively, no visible lesion was seen in lungs of D3 and D4 (Table 3). The liver also showed no visible lesion in D1, D2 and D4 and a few foci of necrosis in D3. However, the kidney of birds showed both interstitial congestion and haemorrhage.

Table 2; Performance of Broiler Chicken Fed Graded Levels of Fungal Degraded Cob Product FDCP)

	Treatment Diets			
parameters	**1**	**2**	**3**	**4**
Initial Weight (g)	600[a]	540[b]	570[b]	530[b]
Final weight (g)	2046[a]	2175[b]	1860[c]	1588[d]
Weight gain (g)	1,440[b]	1635[a]	1290[c]	1058[d]
Mean daily weight gain (g)	34.28[b]	38.93[a]	30.71[c]	25.19[d]
Feed intake (g)	5190[a]	4852[d]	5105[b]	5020[c]
Mean daily feed intake (g)	123.57[a]	115.52[d]	121.54[b]	119.52[c]
Feed conversion Ratio (FCR)	.3.60[c]	2.97[d]	3.96[b]	4.74[a]
Feed Utilization (FU)	0.28[ab]	0.34[a]	0.25[bc]	0.21[c]

Table 3: Histophatological Studies of Experimental Birds Organs (fed FDCP)

Treatment/ Diet	**Liver**	**Kidney**	**Lungs**	**Pancreas**
D1	No visible lesion seen	The interstitial (lymphoid) compartment is reduced in density	Very mild congestion	No visible lesion seen
D2	No visible lesion seen	Marked haemorrhage in the interstitium, few tubular cells are necrotic	Generalized congestion	No visible lesion seen
D3	There are few foci of necrosis and cellular infiltration by mononuclear cells	Mild congestion	No visible lesion seen	No visible lesion seen
D4	No visible lesion seen	Interstitial congestion and haemorrhage	No visible lesion seen	No visible lesion seen

4 DISCUSSION

Significant differences were observed in all the performance parameters of the experimental birds. The value of the feed conversion ratio in D4 (82% FDCP)
was significantly higher than in other diets. This showed that high feed intake does not have a corresponding effect on weight gain. Aderolu*et al*., (2007) also observed that feed conversion efficiency became poor with corresponding incremental level of fibre. This low productive value has been attributed to the possible presence of β – glucan in the added dietary fibres which could give rise to highly viscous conditions in the small intestine and interfere with nutrients absorption (Hesselman and Aman, 1986). The mean daily weight gain was higher in D2 birds (18%) FDCP) than D1 (commercial feed and other diets), this showed that 18% FDCP substitution is beneficial to the birds. The improvement in weight could be attributed to the fact that the birds in the present investigation were able to adopt to the high dietary fiber-rich diet (Onilude and Oso, 1994), which has been partially degraded by the fungal isolate.
There was no significant difference in the feed utilization / efficiency in D1 D2 and D3. This showed that birds fed 18% and 50% were able to utilize their feed for maximum weight gain like the commercial feed. Adeyemi and Familade (2003) also observed that up to 20% fermented maize cob replacement of maize showed little difference in the observed weight gain of the chicken.The lungs and Pancreas of the birds in all the treatments did not show any major symptoms of disease condition. However the liver and kidneys of the birds fed Diets 3 and 4 were affected by the diet. These could be linked to the roles of these organs in the elimination of metabolic wastes and toxins from the body (Olajide, 2012). Hence these organs can easily be affected by the type of diet taken by the birds.The liver of birds fed Diet 3 showed a few foci of Necrotic lesion while the kidneys of the birds in Diets 2 and 4 showed haemorrhage in the interstitium and interstitial congestion and haemorrhagerespectively. Kidney and liver are primary organ of biotransformation in animals (Onyeyili*et al*., 1998) hence, the effect of the diet on these vital organ must be determined.

5. CONCLUSION

Results from this study indicated that maize could economically be replaced by 18% FDCP in the diet of broiler finisher without compromising the quality and quantity of carcass birds and without deleterious effect on the health status of the birds.

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