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NUTRITIONAL AND HEALTH IMPLICATIONS OF DIETARY INCLUSION OF DRIED POULTRY WASTE (DPW) FOR BROILERS

A. B. I. Udedibie and V. N. Omekam
Department of Animal Science and Technology
Federal University of Technology
Owerri, Nigeria

ABSTRACT

Studies were carried out to determine the growth performance of and histopathological changes in broilers fed diets containing dried poultry waste (DPW). DPW was included in broiler starter diets at 0,10,15,20 and 25% levels and each diet fed to a group of 32 broiler chicks for 3 weeks. Thereafter the diets were adjusted to finisher level and fed for another 4 weeks. Feed intake of the birds was significantly affected only at 25% DPW dietary level (P<0.05). The growth rate of the group on 25% DPW level was also significantly depressed (P<0.05). Feed conversion ratio of the group was also significantly depressed (P<0.05). Histopathological investigation revealed no gross lesions in all the liver and kidney tissues examined.

INTRODUCTION

The soybean (*G. max*) and groundnut (*A. hypogaea*) have been playing key role in the feeding of non-ruminants in Nigeria. Since these commodities are becoming increasingly scarce and consequently expensive in view of high demands arising from their multiple uses, there is the need to explore the possibility of incorporating unconventional products in poultry feeds with a view to reducing cost. One such product which is in abundance is the dried poultry waste from caged birds. Utilization of excreta from poultry as feed ingredient in poultry diets is still a matter of research in most tropical countries (Chan, 1993). Poultry waste has been found to contain considerable amounts of nutrients, especially nitrogen and carbohydrates (El-Sabban *et al*, 1969). According to Smith and Calvert (1976), excreta from caged birds contain 4-7% nitrogen on a dry matter basis and is a potential source of nitrogen particularly for ruminants. The works of Fregal and Zindal (1971), Lee and Blair (1973), MacNab *et al* (1974), Biely and Stapleton (1976) and Nitis *et al* (1986) showed that poultry waste could be used to replace protein from other sources in broiler diets, the extent of substitution depending upon the economic climate, ingredient costs etc.

The work herein reported was aimed at determining the growth performance of and histopathological changes in broilers fed diets containing dried poultry waste from caged laying birds.

MATERIALS AND METHODS

Source and Processing of Poultry Waste

The poultry waste used for the trial was collected from the caged layer unit of the Teaching and Research Farm of Federal University of Technology, Owerri. The caged birds were certified to be in apparent good health. They were not under any medication, except routine vitamin supplementation and prophylaxis against helminthiasis, the drug of common use being piperazine-hydrochloride, a non-toxic compound even at many times the recommended dosage level. Moreover, prophylaxis was periodic (once every 3 months).

The waste was sun-dried well before the commencement of the trial. The dried poultry waste (DPW) was then milled and subjected to proximate analysis according to AOAC (1995).

Experimental Diets

Five experimental starter diets were formulated, using five levels of DPW – 0, 10, 15, 20 and 25%. During the finisher phase, the ingredients were adjusted so as to provide appropriate nutrient levels for broilers at that phase. The ingredient compositions of the diets are shown in Table 1. The chemical composition of the experimental diets and DPW is shown in Table 2.

Table 1: Ingredient Composition of the Experimental Diets (Starter and Finisher Phase)*

Ingredients	Dietary Levels of DPW				
	0	10	15	20	25
Maize	50.00(60.00)	45.00(55.00)	42.50(50.00)	40.00(45.00)	37.50(40.00)
DPW	-	10.00	15.00	20.00	25.00
Soybean meal	15.00(12.00)	15.00(12.00)	15.00(12.00)	15.00(12.00)	15.00(12.00)
Ground nut cake	14.00(10.00)	14.00(10.00)	14.00(10.00)	14.00(10.00)	14.00(10.00)
Blood meal	2.00(2.00)	2.00(2.00)	2.00(2.00)	2.00(2.00)	2.00(2.00)
Palmkernel cake	4.00(3.00)	4.00(3.00)	4.00(3.00)	4.00(3.00)	4.00(3.00)
Brewers' Grains	12.00(10.00)	6.50(5.50)	5.00(6.00)	3.50(6.50)	1.50(7.00)
Bone meal	2.50(2.50)	2.00(2.00)	1.50(1.50)	1.00(1.00)	0.50(0.50)
Common Salt	0.25(0.25)	0.25(0.25)	0.25(0.25)	0.25(0.25)	0.25(0.25)
Vit/mineral Premix**	0.25(0.25)	0.25(0.25)	0.25(0.25)	0.25(0.25)	0.25(0.25)

*Values in parenthesis are for finisher diets.

**To provide the following per kg of feed: Vit. A. 10,000 I.U., Vit.D_3 2000; Vit B_1 0.75mg; Vit. B_2 5mg; nicotinic acid, 25mg; Calcium panthothenate, 12.5mg; Vit. B_{12} 2.5mg; Vit. K_3, 2.5mg, Vit. E, 25mg; Biotin, 0.50mg; folic acid, 1.0mg; choline chloride, 250mg; cobalt, 0.40mg; copper, 8.0mg; manganese, 64mg; iron, 32mg; zinc, 40mg; iodine, 0.80mg; DL-methionine, 50mg; L-lysine, 120mg.

Experimental Birds

Anak broilers hatched at S & D Farms, Abeokuta – Nigeria, were used for the trials. Five hundred day-old birds were bought and brooded together for the first two weeks. Thereafter, one hundred and sixty (160) of them were selected, divided into 5 groups of 32 birds each and randomly assigned to the five experimental diets. Each group was further sub-divided into 2 replicates of 16 birds each and each replicate housed in a compartment measuring 2m x 3m.

The birds were fed *ad libitum* using hanging feeders to minimize feed spillage. Water was also given *ad libitum*. Vitalyte^R (vitamin-mineral supplement), Bioxin^R (tetracycline hydrochloride) and coccidiostat (Amprolium-sulfaquinoxaline hydrochloride) and coccidiostat (Amprolium-sulfaquinoxaline mixture) were strategically given at prophylactic levels.

Data Collection

The weight of each bird at the start of the trial (2 weeks of age) was recorded. The weight at 3, 5 and 7 weeks from commencement of the trial was also recorded (ie. at the age of 5, 7 and 9 weeks). Feed intake was determined by subtracting the weight of left-over feed from the quantity offered.

At the 5th, 7th and 9th weeks of age, 4 birds were randomly selected from each replicate, weighed and then decapitated, using artery forceps to ensure that bleeding was minimal and internal. This aimed at ensuring a near normal liver and kidney weight. Each test bird was opened up, with the liver and kidneys completely exteriorized or extirpated. The gross anatomic features of these organs were closely observed to see if there were anatomic aberrations. Other organs, the gastrointestinal tract (GIT), lungs, spleens and the gizzards were closely examined for clinical lesions. The weights of the internal organs were recorded within 10 minutes of slaughter using a triple beam balance.

Histopathological Investigation

Thin sections were made from each liver and kidney. These were fixed in 10% formalin-saline. Tissue sections were then prepared on slides, using the Hematoxylene and Eosine (H and E) staining technique. Prepared slides were subjected to microscopy.

Statistical Analysis

Data on feed intake, body weight gain, feed conversion ratio, liver and kidney weights, liver and kidney weights relative to body weights were subjected to analysis of variance as outlined by Snedecor and Cochran (1978). Where analysis of variance indicated significant treatment effects, means were compared using Duncan's multiple range test as also outlined by Snedecor and Cochran (1978).

RESULTS AND DISCUSSION

Chemical Composition of DPW and Experimental Diets

The analysed and calculated nutrient composition of the experimental diets and the dried poultry waste are shown in Table 2. The metabolizable energy values of the diets decreased with increased levels of DPW, the 25% dietary level having the lowest values of 2.6kcal/gm and 3.0cal/gm for the starter and finisher diets, respectively. These were reflections of the low energy value of DPW as reported by Nitis *et al* (1986).

Performance of the Experimental Birds

Data on the performance of the experimental birds are shown in Table 3.

There were no significant differences (P<0.5) in the feed intake of the control group and the groups on 10, 15 and 20% DPW. The feed intake of the group on 25% DPW was significantly (P<0.05) lower than that of the control group but not significantly different from those of the groups on 10, 15 and 20% DPW. The general tendency of birds to feed to satisfy their energy requirement was not observed in this study. Similar observation had earlier been made by Biely and Stapleton (1976). They therefore concluded that birds fed different levels of DPW failed to increase feed consumption or compensate for the lower energy because of possible other factors present in DPW. The results, however, contradicted that of Esonu (1991) who reported increase in feed intake with increase in dietary levels of DPW.

Both the final body weights and growth rate of the groups followed the pattern of feed intake. At dietary level of 25% DPW, the final body weights and growth rate of the birds became significantly (P<0.05) lower than those

Table 2: Chemical Composition of the Experimental Diets and DPW (% of Dry Matter)*

Nutrients	Dietary Levels of DPW					
	0	10	15	20	25	DPW
Crude Protein	23.9(19.4)	23.9(19.2)	23.8(19.1)	23.5(18.9)	23.3(18.8)	13.50
Ether Extract	3.9(3.8)	3.5(3.5)	3.2(3.6)	3.1(3.5)	3.0(3.5)	5.25
Total Ash	11.8(9.2)	11.3(9.6)	11.1(9.6)	11.1(10.2)	12.4(11.2)	22.50
Crude Fibre	5.9(6.1)	5.4(6.2)	5.7(6.4)	6.0(6.8)	5.7(6.9)	13.40
Calcium	0.9(0.8)	0.9(0.9)	0.9(0.9)	0.8(0.9)	0.8(0.9)	5.10
Phosphorus	0.5(0.5)	0.4(0.5)	0.4(0.6)	0.4(0.6)	0.4(0.6)	1.60
L-Lysine**	1.2(1.1)	1.2(1.0)	1.2(1.0)	1.1(1.0)	1.1(1.0)	-
Methionine Cystine**	0.6(0.7)	0.7(0.7)	0.7(0.8)	0.7(0.8)	0.7(0.8)	-
Metabolizable Energy(Kcal/gm)**	3.1(3.3)	2.9(3.3)	2.8(3.2)	2.7(3.1)	2.6(3.0)	2.1***

* Value in parenthesis are for the finisher diets

** Calculated Values

*** Adapted from Nitis et al (1986).

Table 3: Performance of the Experimental Birds

Parameters	Dietary Levels of DPW					SEM
	0	10	15	20	25	
Initial body wt. (gm)	284.0	286.0	288.0	290.0	280.0	1.02
Final body wt. (gm)	2042.0^{a}	1956.0^{a}	1948.0^{a}	1932.0^{a}	1837.0^{b}	15.40
Av. feed intake (gm/d)	148.2^{a}	145.5^{ab}	144.8^{ab}	144.5^{ab}	143.7^{b}	1.33
Av. body wt. gain at 5wks.	852.0^{a}	861.5^{a}	866.5^{a}	740.0^{b}	744.0^{b}	4.06
Av. body wt. gain at 7wks.	1314.5^{a}	1345.8^{a}	1298.5^{ab}	1248.4^{b}	1232.6^{b}	13.04
Av. body wt. gain at 9wks.	1758.0^{a}	1670.0^{a}	1660.5^{ab}	1635.0^{ab}	1557.5^{b}	4.14
Av. daily wt. gain (gm)	50.2^{a}	47.7^{a}	47.4^{a}	46.7^{ab}	44.5^{b}	0.10
Feed conversion ratio (g feed/g gain)	2.95^{a}	3.05^{a}	3.03^{a}	3.07^{a}	3.22^{b}	0.02
Mortality (numbers)	3	0	0	0	0	-

ab Means within a row with different superscripts are significantly different ($P<0.05$)

Table 4: Effect of DPW on the Weights and Relative Weights of Liver and Kidneys of the Experimental Birds with Time

Parameters	Dietary Levels of DPW					SEM
	0	10	15	20	25	
(5th week)						
Av. body wt. (gm)	1134.0^{a}	1141.0^{a}	1138.2^{a}	1038.0^{b}	1021.5^{b}	3.11
Av. liver wt. (gm)	31.3^{a}	29.5^{a}	31.3^{a}	22.4^{b}	24.8^{b}	0.35
Av. kidney wt. (gm)	10.0^{a}	7.0^{b}	8.4^{ab}	6.7^{b}	8.4^{ab}	0.12
Relative liver wt. (%)*	2.76^{a}	2.59^{a}	2.75^{b}	2.16^{b}	2.43^{ab}	0.06
Relative kidney wt (%)*	0.88^{a}	0.61^{b}	0.74^{a}	0.65^{b}	0.82^{a}	0.01
(7th Week)						
Av. body wt. (gm)	1598.2	1578.0	1586.0	1534.2	1510.8	14.58
Av. liver wt. (gm)	44.3^{a}	51.9^{b}	46.3^{a}	43.3^{a}	45.0^{a}	1.16
Av. kidney wt. (gm)	12.2^{b}	14.1^{a}	12.8^{b}	13.9^{a}	12.5^{b}	0.18
Relative liver Wt (%)*	2.80^{b}	3.31^{a}	3.0^{ab}	2.8^{b}	3.0^{ab}	0.023
Relative kidney wt (%)*	0.76^{b}	0.89^{a}	0.81^{b}	0.91^{a}	0.82^{b}	0.014
(9th Week)						
Av. body wt. (gm)	2032.0^{a}	1986.0^{a}	1950.0^{a}	1934.0^{ab}	1838.0^{b}	9.31
Av. liver wt. (gm)	46.6^{a}	52.5^{b}	55.1^{b}	54.5^{b}	52.0^{b}	1.32
Av. kidney wt. (gm)	13.8^{a}	14.6	15.8^{b}	17.2^{b}	13.7^{a}	0.11
Relative liver wt(%)*	2.39^{a}	2.64^{b}	2.85^{b}	2.82^{b}	2.83^{b}	0.03
Relative kidney wt (%)*	0.68^{a}	0.74^{ab}	0.81^{b}	0.89^{b}	0.75^{ab}	0.006

ab Means within a row with different superscripts are significantly different ($P<0.05$).

*Percent of body weight.

of the control group. This result contradicted the findings of Lee and Blair (1973) and Esonu (1991) that DPW increased growth rate of broilers. It, however, agreed with the findings of Flegal and Zindel (1971) which showed that birds fed on diets containing up to 20% DPW grew as well as the control. The group on 25% DPW also recorded the lowest feed conversion ratio, showing that at dietary levels above 20%, DPW tends to depress efficiency of feed utilization.

Three birds died from the control group during the trial. No external lesions were found on the dead birds neither did the post-mortem examination reveal the cause of death. The absence of mortality in the test groups appeared indicative of the safety of use of DPW, except perhaps when obviously contaminated by pathogens.

Internal Organs

Data on the weights and relative weights of the visceral organs of the birds at the 5th, 7th and 9th weeks of the trial are shown in Table 4. The liver and the kidney are the major visceral organs involved in nutrient metabolism. They are not exclusive in this function but form the major organs. As a result, observations were centered on them. There was no pattern of progression in both the weights and relative weights (% of body weight) of the organs. It appeared therefore that liver and kidney weights were not subject to alterations due to dietary levels of DPW up to 25%.

Structure of Visceral Organs

Macroscopy

No gross lesions were observed in all the liver and kidney tissues examined. The organs maintained their normal structures and contours. There were also no discolorations neither were there adhesions between the organs.

Histopathology

Data on the histopathological investigation are shown in Table 5. No lesions of pathological significance were observed. However, there were some changes in focal mononuclear cellular reactions, necrosis of hapatocytes and atrophic hepatocytes. The kidney showed slight focal intercellular reactions and nephritis, but the lesions were not observed at pathologic levels and were therefore pathologically insignificant.

It is worthy to note that more of the lesions observed occurred within the control group. The 25% DPW group had the least of these lesions. The inference therefore was that the lesions did not arise as a result of the presence DPW in the diets. The control diet had highest levels of maize, spent grains and bone meal. One could therefore infer that the histologic changes, though not significant, probably arose as a result of the organs trying to adjust to the

Table 5: Effect of DPW on Histopathological Structure of the Livers and Kidneys of the Experimental Birds

Parameters	Dietary Levels of DPW				
	0	10	15	20	25
Fatty change (liver)	+	-	-	-	-
Mononuclear cellular reaction (liver)	+++	++	+	+	-
Portal fibrosis (liver)	+	-	-	-	-
Hepatic necrosis (liver)	-	+	-	+	+
Intercellular reaction (kidney)	++	+	-	-	-
Nephritis(kidney)	-	-	-	+	-

+: Relative presence of histopathological structure
-: Absence of histopathological structure.

high levels of any of these substances.

CONCLUSION

The results of this study have shown that DPW could be incorporated in broiler diets up to 20% without deleterious effects. The results have also shown that dietary inclusion of DPW up to 25% leads to no pathological complication in the liver or the kidney or general health of the birds. It is therefore recommended that dietary inclusions of DPW in broiler diets should be restricted to levels not exceeding 20%.

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