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EFFECT OF DIETARY LEVELS OF FEATHER MEAL ON DIGESTIBILITY, HAEMATOLOGY AND CARCASS CHARACTERISTICS OF BROILER CHICKENS

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ABSTRACT

The effects of feeding graded levels of feather meal on digestibility, hematological parameters and carcass characteristic of broilers (Amo) chickens were evaluated. The feather meal was included at 0, 2.5, 5, 7.5 and 10% levels into diets T1, T2, T3, T4 and T5 respectively as replacement for fish meal. One hundred and fifty (150) four week Hover Marshal broiler strain were randomly assigned to five diets in a completely randomized design (CRD). Each treatment was replicated three times with10 birds per replicate. At the end of the feeding trial, nine birds from each treatment were selected for digestibility, hematologicaland carcass characteristics. The nutrient digestibility of dry matter and ether extract were not significantly ($P>0.05$) different among the treatment groups while crude protein and crude fibre digestibility were affected ($P<0.05$). Broiler chickens fed diets containing 5% feather meal (diet T3) utilized better crude protein and crude fibre compared to those fed diet T5 (10% feather meal), but similar ($P>0.05$) to other treatments. Most of the hematological parameters were not affected ($P>0.05$%) by the feather meal inclusion level in the diets but only red blood cell count, mean corpuscular volume and mean corpuscular hemoglobin($P<0.05$). The haematological values were within the normal ranges of healthy broiler chickens. The carcass characteristicsindicated that drumstick, wings, head, spleen, heart, intestine and liver were not significantly ($P>0.05$) different among the treatment groups while others were ($P<0.05$) However, broiler chickens fed diet T5 recoded lowest values for most of the carcass parameters but other treatments were similar ($P>0.05$). It was concluded that up to 7.5% feather meal can replace fish meal without adverse effect on the digestibility, hematological and carcass parameters of broiler chickens.

Keywords: Broiler chickens; Feather meal; Digestibility; Haematological parameters; Carcass characteristics

INTRODUCTION

Increase in price of feed ingredients in developing countries has greatly reduced the rate of expansion of the poultry industry and the protein intake of Nigerians has declined as a result of increasing human population (FAO, 1991). This level of animal protein consumption has direct influence on the general well-being and health of the populace. Poultry production especially the broiler chicken remains one of the veritable ways of achieving sustainable and rapid production of high quality protein to meet the increasing demand of the Nigerian teeming populace (Apata and Ojo, 2000).

Recent studies indicated that feather meal can be easily processed and inserted into broiler ration. However, feather meal is characterized by low digestibility in non-ruminants. The feather meal is deficient in methionine, an amino acid that improves growth performance (Papadopoulos *et al*., 1985). This study has, therefore, evaluated the effect of feeding different levels of feathe rmeal on digestibility, hematology and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

Experimental Animals and Management

The study was conducted at the Livestock Teaching and Research Farm, University of Maiduguri, Maiduguri, Borno State, Nigeria. One hundred and fifty (150) four week Hover Marshal breed broiler chickens were randomly assigned to five treatment diets. Each treatment was replicated three times with 10 birds per replicate. The experimental diets and fresh drinking water was offered *ad libitum* throughout the experimental period of four weeks. The birds were vaccinated against Gumboro disease at weeks 2 and 5 and Newcastle disease at week 3.

Processing of Feather Meal

Plucked feather were collected from the Monday-Market in Maiduguri, Borno State. The feather was boiled (at 100^0C) for 10-15 minutes. The moisture content of the feather material was reduced to 40-50% by placing it on a metallic wire for 10 minutes.The feathers were then spread on clean concrete floor and sundried for a period of one (1) week to obtain a 95% dry matter . The processed material was then ground to reduce bulkiness. It was then stored in a tightly nylon bags until the time of the experiment.

Experimental Diets

The ingredients composition of broiler finisher diets is presented in Table 1. The experimental diets were compounded using Maize, soybean meal, groundnut cake, wheat offal, feather meal, fish meal, bone meal, limestone, methionine, lysine, common salt and premix. In each diet, the feather meal replaced fish meal at levels 0, 2.5, 5, 7.5 and 10% for diets T1, T2, T3, T4 and T5, respectively. The proximate composition of the experimental diets was analyzed using AOAC procedure (AOAC, 2000).

Table 1: Ingredients composition of broiler finisher diets

Ingredients	Treatment (inclusion level of feather meal) (%)				
	T1 (0)	T2 (2.5)	T3 (5)	T4 (7.5)	T5 (10)
Maize	65.36	65.36	65.36	65.36	65.36
Groundnut cake	6.64	6.64	6.64	6.64	6.64
Soya bean meal	4.00	4.00	4.00	4.00	4.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Feather meal	0.00	2.50	5.00	7.50	10.00
Fish meal	10.00	7.50	5.00	2.50	0.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Common salt	0.35	0.35	0.35	0.35	0.35
*Premix	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100

* Premix (grow fast) Manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplying the following per kg of premix: Vitamin A, 5000,000 IU; Vitamin D_3 800,000IU; Vitamin E, 12,000mg; Vitamin K, 1,5000mg; Vitamin B_1, 1,000mg; Vitamin B_2, 2,000mg, Vitamin B_6, 1,500mg; Niacin, 12,000mg; Pantothenic acid, 20.00mg; Biotin,10.00mg; Vitamin B_{12}, 300.00mg; Folic acid, 150,000mg; Choline, 60,000mg; Manganese, 10,000mg; Iron;15,000 mg, Zinc 800.00mg; Copper 400.00mg; Iodine 80.00mg; Cobalt 40mg; Selenium 8,00 mg

Digestibility Study

The digestibility study was conducted at the end of the feeding trial. Faecal samples were collected from nine birds in each treatment (i.e. three (3) from each replicate) for a period of seven days using fine wire mesh trays placed under the cages. The amount of faeces voided daily was weighed and allowed to dry for 24 hours at 80^0C in an oven. The dried faecal samples were then stored in air -tight containers for chemical analysis. The proximate composition of the diets and faecal samples were determined according to AOAC procedure (2000).

Hematological Parameters

At end of the experiment, blood samples were collected randomly from three (3) chickens per replicate (i.e nine chickens in each treatment) for the determination of the hematological indices. The blood samples were collected in sample bottles containing dipotassium salt of ethylene diamine–tetra acetic acid (EDTA–K^{2+}) which served as an anticoagulant. The hematological analysis of blood samples were carried out at the Department of Animal Science, University of Maiduguri, Nigeria, using the routinely available clinical methods (Bush, 1975). The hematological indices determined were packed cell volume (PCV), hemoglobin concentration (Hb), red blood cell (RBC) counts and white blood cell (WBC) counts and differential counts. Mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were obtained from calculation according to the procedure employed by Jain (1986).

Carcass Characteristics

At the end of the experiment, three (3) chickens from each replicate (i.e nine chickens in each treatment) based on average weight of the group from each treatment, were selected for slaughter. The chickens were weighed in the morning and slaughtered by cutting transversely across the trachea, esophagus, large carotid arteries and jugular veins to ensure maximum bleeding (Mann, 1960). Slaughtered birds were scalded in hot water (about 50^{o}C) for 1 minute; plucked manually. Dressing percentage was obtained as percentage of the dressed weight after removing the feather. They were then eviscerated for carcass yield and organs weight determination. The carcass yield and organs weight were weighed and calculated as percentage of the dressed weight.

Data Analysis

All the data collected were subjected to analysis of variance (ANOVA) using the completely randomized design (Steel and Torrie, 1980). Means were separated where applicable using the Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate Composition of Experimental Diets

The proximate composition of the experimental diets is shown in Table 2.The crude protein, crude fiber and ether extract values were similar among the diets and values were adequate as recommended by Olomu (2011). The ash content of the diets slightly increased as the level of feather meal increased in the diets while nitrogen-free extract decreased. The metabolizable energy was similar among the treatment diets and within the range recommended by Olomu (2011).

Table 2: Proximate composition of experimental diets%

Nutrients	Treatment (inclusion level of feather meal) (%)				
	T1 (0)	T2 (2.5)	T3 (5)	T4 (7.5)	T5 (10)
Dry Matter (%)	83.90	93.95	93.70	93.25	94.05
Crude Protein (%)	19.25	19.39	19.53	19.67	20.80
Crude Fibre (%)	8.57	8.56	8.56	8.58	9.0
Ether Extract (%)	3.50	3.50	3.00	3.00	3.00
Ash (%)	3.50	3.80	4.50	5.50	6.00
NFE (%)	65.18	64.75	64.41	63.25	61.20
ME (kcal/kg)	3238.64	3274.71	3287.67	3287.17	3185.20

ME = Metabolizable energy calculated according to the formula of Pauzenga (1985): ME = 37x% CP+81x%EE+35.5 x %NFE NFE = Nitrogen-free extract

Nutrient Digestibility of Broiler Chickens Fed Different levels of Feather Meal

The nutrient digestibility of broiler chicken fed different levels of feather meal is shown in Table 3. The results showed that the dry matter and ether extract digestibility were not significant (P>0.05) among the treatment groups while crude protein and crude

fibre digestibility were (P<0.05). Broiler chickens fed diet T3 diet (5% feather meal) utilized better crude protein and crude fibre compared to those fed diet T5, but similar (P>0.05) to other treatments. This finding is similar to the work of Ajayi (2014) who fed graded levels of hydrolyzed feather meal in the diets of broiler chickens.

Table 3: Nutrient Digestibility of Broiler Chickens Fed Different Levels of Feather Meal

Parameters (%)	Treatment (inclusion level of feather meal) (%)					
	T1 (0)	T2 (2.5)	T3 (5)	T4 (7.5)	T5 (10)	SEM
Dry Matter	88.86	85.21	86.02	88.86	82.61	7.82 ^{NS}
Crude Protein	77.03^{ab}	79.25^{ab}	88.63^{a}	77.03^{ab}	67.18^{b}	7.96 *
Crude Fibre	67.60^{ab}	65.24^{ab}	84.70^{a}	67.60^{ab}	51.17^{b}	8.53 *
Ether Extract	82.76	82.78	82.01	82.76	81.32	6.04 ^{NS}

SEM = Standard error of mean; NS = Not significantly different (P>0.05); * = Significantly different (P<0.05) and Means in the same row with different superscripts are significantly different (P<0.05)

Hematological Parameters of Broiler Chickens Fed Graded Levels of Feather Meal

Hematological parameters of broiler chickens fed feather meal are shown in Table 4. All the hematological parameters measured were not significantly (P>0.05) different expect red blood cell, mean corpuscular volume and mean corpuscular hemoglobin.The packed cell volume values (25.66-28.66%) were within the range from 25 to 45% as reported by Anon (1980). This means that protein of the diets was not affected by the inclusion of feather meal in the diets. The hemoglobin concentration values (8.50-9.53g/100ml) obtained falls within the ranged (7-13g/100ml) as observed by Anon (1980).

The broiler chickens fed diet T4 had the highest RBC values compared to other treatments but similar to those fed diet T3. The red blood cell (RBC) values obtained (21.00-27.00x$10^6$$mm^3$) were within the range of 25-32 10^6/mm^3 reported by Anon (1980). The function of the RBC is to transport hemoglobin, which in turn carries oxygen from the lungs to the tissues (Bush, 1991). As a result, the higher value of RBC in diet T4 is a clear indication that the chickens were free from blood related disease like anemia.The white blood cell values (16.00-17.00x10^3/mm^3) were within the normal ranged (9-31x 10^3/mm^3) for healthy chicken as reported by Anon (1980). Bush, (1991) reported that high level of white blood cell (WBC) indicates that the body is fighting infection while lower value shows problems with the bone marrow production which was not seen in the animals of the present study.

The animals fed diet T4 recorded lowest value of mean corpuscular volume (MCV) compared to other treatments. The MCV values which ranged between 12.12 and 12.57fl is comparable to other reports (Anon, 1980) for normal healthy chickens. Bush (1991) explained that the MCV values aid in assessing the anemia conditions of an animal and the capacity of the bone marrow to produce red blood cells of normal size and metabolic capacity. This observation was supported by Anon (1980) who reported that hemoglobin reflects the responsiveness of the animal to its internal and external environment which includes nutritional status.The mean corpuscular hemoglobin values obtained from the present study which ranged from 3.15 to 4.47pg also tallies with the values reported by Anon (1980). The chickens fed diet T1 had the highest value compared to those fed other

treatment diets. However, lowest value was obtained from animals fed diet T4. The values were however within the range recommended by Gambo *et al.* (2011).The mean corpuscular hemoglobin concentration values range from 33.13 to 35.85% were within the ranged32 to 42% as recommended by Gambo *et al.* (2011). The differential counts (%) parameters are associated with body defense mechanism. All the parameters were not significantly (P>0.05) different among the treatment groups. The values are within the reference values for healthy chicken as recommended by Gambo *et al.* (2011).

This is an indication that the diets are adequate in nutrient to support the healthy condition of broiler chickens.

Table 4: Hematological parameters of broiler chicken fed graded levels feather meal

Parameters	Treatment (inclusion level of feather meal) (%)					
	T1 (0)	T2 (2.5)	T3 (5)	T4 (7.5)	T5 (10)	SEM
Packed cell volume (%)	26.33	28.66	28.66	25.66	25.66	1.51^{NS}
Hemoglobin concentration (g/100ml)	9.33	9.50	9.53	8.50	8.53	0.37^{NS}
Red blood cell count ($x10^6mm^3$)	21.00^b	23.00^b	23.66^{ab}	27.00^a	22.00^b	1.05^*
White blood cell($x10^6mm^3$)	16.00	16.00	16.00	16.66	17.00	1.39^{NS}
Mean corpuscular volume (fl)	12.57^a	12.51^a	12.12^a	9.50^b	11.69^a	0.53^*
Mean corpuscular hemoglobin (pg)	4.47^a	4.14^{ab}	4.03^b	3.15^c	3.89^b	0.13*
Mean corpuscular hemoglobin concentration (%)	35.85	33.13	33.25	33.12	33.24	1.12^{NS}
Differentialcount (%)						
Monocytes	8.33	2.78	0.33	0.33	0.08	0.19^{NS}
Neutrophils	44.00	38.33	40.00	38.33	45.41	9.36^{NS}
Eosinophils	3.33	1.66	1.66	1.66	0.16	1.15^{NS}
Lymphocytes	52.66	60.00	59.66	58.00	54.83	9.46^{NS}

SEM**:** Standard Error of Mean, NS= Not significant (P> 0.05) difference; *= Significant (P<0.05) difference, abc= Means in the same row with different superscripts are significantly different (P<0.05)

Carcass Characteristics

Carcass characteristics of broiler chickens fed the experimental diets are shown in Table 4.The drumstick, wings, head, spleen, heart, intestine and liver were not significantly (P>0.05) different, while others were significantly (P<0.05) different among the treatment groups. The values obtained for drumstick, spleen, liver and heart were similar to the values reported by Isika *et al.* (2006). This reflected that feather meal does not have any negative effect on these parameters.

The slaughter weight, bled weight and dressed weight of animals fed diet T5 was the lowest value compared to others groups having similar values. Back weight and shanks for diet T1 was the highest compared with diet T5 but were similar to diet T2, T3 and T4. Dressing percentage and abdominal fat of animals fed diet T2 t had the heaviest weight. The lowest value was obtained in diet T5, but similar to those fed other diets. Plucked

weight was significantly (P<0.05) higher in broilers fed diet T2 similar to those fed diet T1. Breast weight was heavier for animals fed diet T2 compared to those fed diet T5 which had the lowest value. Neck had the highest value in diet T3 similar to diet T1 and T2. Gizzard was higher significantly (P<0.05) in diet T4 and was similar to diet T1, T3 and T5. Lungs had the highest value for animals fed diet T1 but those fed diet T2 had the lowest. However most of the parameters followed a similar trend as observed by Muhammad *et al*. (2014) and Nakhash, (2008)). Based on this finding up to 7.5% level of feather meal can be included in broiler chickens diet without adverse effect on carcass characteristics.

Table 5: Carcass characteristics of chicken fed experimental diets

Parameters %	Treatment (inclusion level of feather meal) (%)					
	T1 (0)	T2 (2.5)	T3 (5)	T4 (7.5)	T5 (10)	SEM
Slaughter weight	2000.00^{a}	2033.30^{a}	2000.00^{a}	1933.30^{a}	1600.00^{b}	57.74*
Bled weight	1950.00^{a}	1933.30^{a}	1950.00^{a}	1883.30^{a}	1550.00^{b}	0.05*
Plucked weight	1503.30^{ab}	1552.30^{a}	1250.70^{b}	942.70^{c}	930.30^{c}	87.79*
Dressed weight	1113.70^{a}	1092.70^{a}	1174.30^{a}	1033.00^{a}	766.30^{b}	58.90*
Dressing percentage	180.78^{ab}	211.58^{a}	190.06^{ab}	188.74^{ab}	172.33^{b}	11.65*
Drumstick	156.00	126.33	158.00	145.67	120.67	12.30^{ns}
Thigh	179.33^{ab}	198.67^{a}	193.00^{a}	166.00^{ab}	148.00^{b}	12.25*
Breast weight	230.67^{bc}	312.00^{a}	251.67^{abc}	272.33^{ab}	197.00^{c}	21.60*
Back weight	284.00^{a}	254.00^{ab}	246.33^{ab}	264.33^{ab}	167.67^{b}	31.29*
Wings	153.00	140.00	134.67	141.67	112.67	13.90^{ns}
Neck	88.33^{ab}	90.00^{ab}	113.00^{a}	67.67^{b}	67.00^{b}	9.97*
Head	50.00	32.67	49.00	50.00	40.33	5.67^{ns}
Shanks	75.33^{a}	70.33^{ab}	74.00^{ab}	75.00^{ab}	64.00^{b}	3.46*
Gizzard	62.00^{ab}	50.33^{b}	66.00^{ab}	78.67^{a}	63.33^{ab}	6.07*
Lungs	19.67^{a}	8.67^{c}	11.67^{bc}	16.33^{ab}	11.33^{bc}	2.07*
Abdominal fat	54.00^{ab}	59.67^{a}	49.67^{ab}	32.33^{ab}	24.33^{b}	9.70*
Spleen	2.33	2.67	2.00	2.33	2.00	0.40^{ns}
Heart	12.00	9.00	11.33	11.00	9.67	1.83^{ns}
Intestine	113.33	97.67	118.67	109.67	100.67	15.31^{ns}
Liver	34.00	36.33	38.67	38.33	34.00	3.99^{ns}

SEM**:** Standard Error of Mean; NS = Non Significant (P > 0.05) difference, * = Significant (P<0.05) difference; a, b, c =Means within the same row with different superscripts are significantly different (P<0.05)

CONCLUSION

Based on the digestibility, hematological indices and carcass characteristics finding, up to 7.5% feather can be included in the diets of broiler chickens without adverse effect on the health status and carcass yield of the broiler chickens. Different processing methods should be employed to enhance utilization of the feather meal in broiler chickens.

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