Response of exotic turkey (*Meleagris gallopavo*) poults to diets substituted with varying levels of hydrolysed feather meal or blood meal as partial replacement for fish meal

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Abstract

Recent concerns over the seasonal availability and high cost of conventional protein sources has necessitated the search for alternative feed protein with lesser feed-food competitive properties yet desirable and appropriate to poults. A study was designed to determine the response of exotic turkey poults (Meleagris gallopavo) to diets substituted with varying levels of hydrolysed feather meal (HFM) or blood meal (BLM) as partial replacement for fish meal for 112days. One hundred and ninety-two British United Turkeys BUT) were allotted to eight dietary treatments comprising four replicates and six birds per replicate. The birds were arranged in a 2 × 4 factorial arrangement of two protein sources (Hydrolysed feather meal or Blood meal) included at 4 levels (0, 10, 20 and 30%). Diets 1-4 were formulated such that fish meal in control was replaced by feather meal, protein for protein. Diets 5-8 were formulated such that fish meal in control was replaced by blood meal, protein for protein and included at 0, 10, 20 and 30%. Treatments 1 and 5 were the control groups. Data obtained were subjected to Analysis of Variance using SAS. Turkeys fed test ingredients at 20% substitution level recorded higher (p<0.05) final weight and weight gain and best FCR at starter phase. Cost of feed/kg diet reduced (p<0.05) as the substitution level of test ingredient increased. Nutrient digestibility and energy metabolisability increased with increased substitution levels of test ingredients at the starter phase. Starter turkeys fed hydrolysed feather meal recorded higher energy metabolisability. It can be concluded from this study that substituting turkey diets with Hydrolysed feather meal and Blood meal at 20% inclusion level improves performance, nutrient digestibility and energy metabolisability.

Keywords: Hydrolysed feather meal, Blood meal, British United Turkeys

Introduction

There has been general scarcity of conventional feed sources especially protein such as soyabean meal (SBM) and fish meal (FM) and where available, sharp increase in the price of these products have made their use uneconomical. For this reason, there has been continuous search for products or by-products that can substitute for conventional sources of protein (especially soyabean meal and fish meal). The crude protein content of feather does not suffer from the demerit of anti-nutritional factors like tannin, lectin saponin, glucosinolates and trypsin inhibiting factor. However, the crude protein content of raw feathers are relatively insoluble with poor digestibility of about 5% due probably to the high keratin content and the strong disulphide bonding of the amino acids (Chandler, 2007) hence, processing of the waste resulted into serious problem. In order to avoid wasting resources, the waste should be processed, recycled and used for secondary purposes as a raw material. The disposal of feathers is a formidable problem for the poultry industry. A very efficient and cost-effective method of **disposal** is to feed the feathers back to poultry **as** feather meal, provided this feed component does not negatively affect performance (Charles *et al*., 1996). Blood meal is a by-product of the slaughtering industry and is used as a protein source in the diets of non-ruminants and ruminants. The quality of blood meal`s protein is affected by methods of preparation (McDonald *et al.,* 1992), so that finding a variation in the quality of products from different animal processing plants is not uncommon. Blood meal is very rich in lysine and is a good source of arginine, methionine, cystine, leucine but is very poor in isoleucine and contain less glycine than either fish meal or bone meal (NRC, 1994). Blood meal can compensate the lysine and methionine deficiencies in vegetable protein based diets (McDonald *et al.,* 1992). The characteristic smell of blood meal reduces its palatability and then a 5% limit is a usual recommendation for its usage in diets. Mostly, blood meal is being used as by-pass protein ingredient in ruminant diet (Kamalak *et al.,* 2005).

Materials and methods

The experiment was carried out at the Turkey Unit of the Research Farms of Federal University of Agriculture, Abeokuta (FUNAAB) located on latitude 7°10'N, longitude 3°2'E and altitude 76m above sea level. Two hundred day-old British United Turkey (BUT) poults (average initial weight (56 ± 0.5 g) were purchased for this experiment. The birds were brooded for 28 days (Pre-starter phase) during which a commercial pre-starter diet was offered. Brooding was done on the floor of deep litter pen using electric bulbs as source of heat. During brooding, temperature was maintained at 36 °C for first 0-2days and then gradually reduced by 2 °C per week to a final ambient temperature of 27 °C at the last week of brooding. Feed and water were supplied to the birds *ad libitum*. All routine vaccinations and necessary medications were administered to the birds. Litter was changed regularly to prevent build-up of pathogens. After 28 days of brooding, the poults were randomly allocated to dietary treatments. One hundred and ninety two (192), four weeks old BUTs were assigned to 8 dietary treatments in a 2 × 4 factorial arrangement of two protein sources namely feather meal or blood meal included at four levels; 0, 10, 20, 30%. Diets 1-4 were formulated such that fish meal in control was replaced by feather meal, protein for protein. Each treatment was replicated four times with 6 turkeys each. The experimental diets are as shown on Table 1. Diets 5-8 were formulated such that fish meal in control was replaced by blood meal, protein for protein and included at 0, 10, 20 and 30%. Treatments 1 and 5 were the control groups. The crude protein (CP) and metabolizable energy (ME) contents of the feeds was balanced within the recommended range for turkey starters (NRC, 1994), as shown in Table 1.

Data obtained from this study were subjected to analysis of variance using SAS (1999). Significant means were separated using Duncan Multiple Range Test (Duncan, 1955). In addition, polynomial contrast **(**linear, quadratic) was also used to determine the trend of feather meal and blood meal substitution levels.

Results and discussion

The effect of HFM and BLM on performance of exotic poults is shown in Table 2. The result showed that interaction between substitution level and protein

Table 1 : Ingredients and chemical composition of experimental diets (29-56days)

Ingredients	HFM				BLM			
	0	10	20	30	0	10	20	30
Maize	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
Fish Meal (65%CP)	90.00	82.70	75.40	68.10	90.00	82.95	75.90	68.90
Feather Meal	-	7.30	14.60	21.90	-	-	-	-
Blood Meal	-	-	-	-	-	7.05	14.10	21.10
Soybean Meal	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
Palm oil	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Wheat Offal	5.00	7.00	9.00	11.00	5.00	7.00	9.00	11.00
Bone Meal	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Limestone	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Lysine	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
DL Methionine	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
*Vit/trace mineral Premix	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Common Salt	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
TOTAL	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**
Calculated analyses (g/kg)								
ME (Kcal/kg)	12.04	11.95	11.86	11.78	12.04	11.95	11.86	11.78
Crude protein	260.60	256.00	251.40	246.80	260.60	261.10	261.70	262.20
Fat	38.20	36.60	37.00	36.40	38.20	38.30	38.50	38.60
Crude fibre	29.30	29.30	29.20	29.10	29.30	29.30	29.30	29.30
Calcium	12.80	12.50	12.20	11.90	12.80	12.70	12.50	12.40
Phosphorus	5.30	5.20	5.10	4.90	5.00	5.30	5.30	5.30
Lysine	15.70	15.50	15.30	15.00	15.10	16.00	16.20	16.50
Methionine	6.60	6.50	6.30	6.10	6.20	6.60	6.60	6.60

* Turkey starter premix composition per Kg diet: vit A: 40, 000IU, vit D_3: 4000IU, vit E:40.0 mg, vit K_3: 8mg, vit B_1: 1.0mg, vit B_2: 8mg, vit B_6: 5mg, vit B_{12}: 0.025mg, Niacin: 60mg, Panthothenic acid: 20mg, Folic acid: 2000mg, Biotin: 150mg, , Iron: 32mg ,Manganese: 64mg, Zinc: 40mg, Copper: 8mg, Cobalt: 80mg, Iodine:0.15mg, Selenium: 0.2mgCholine: 300mg

source was not significant (P>0.05) for cost of feed/kg weight gain. Poults fed diet containing 0, 10, 20 and 30% substitution of hydrolysed feather meal or blood meal for fish meal recorded the highest final weight and weight gain except for the group that received 30% substitution level of blood meal for fish meal. There was an interaction effect (P<0.05) between substitution level and protein source for FCR. Birds fed proportion of blood meal as partial replacement for fish meal tended to have higher feed cost/kg weight gain than the control and their counterparts fed hydrolysed feather meal. The least feed cost/kg weight gain among birds fed the two test ingredients was for those fed diets in which hydrolysed feather meal replaced fish meal at 30% substitution level.

The best feed conversion ratio was obtained with turkeys fed 0% substitution level, that is, fish meal diet of feather meal. This might be attributed to the fact that the test ingredients may be deficient in some amino acids, therefore diets containing higher substitution levels were deficient in quite a number of amino acids. This may have contributed to the worst FCR recorded. The fact that mortality was not affected at the starter phase showed that substitution level of hydrolysed feather meal and blood meal used in this study did not pose any toxic or deleterious effect that could lead to the death of the animals. From the economic point of view, results of this study showed that inclusion of feather meal

Table 2: Effect of HFM and BLM on performance of turkeys (29-56days)

Parameters	Replacement level of HFM for fish meal				Replacement level of BLM for fishmeal				SEM	P-Value
	0	10	20	30	0	10	20	30		
Initial weight(g/b)	1606.25	1625.00	1612.50	1618.75	1643.75	1631.25	1637.5	1618.75	5.08	0.576
Final weight(g/b)	4262.50^{a}	4262.5^{a}	4325.0^{a}	4270.00^{a}	4287.5^{a}	4162.5^{a}	4225.0^{a}	3937.50^{b}	28.58	0.056
Weight gain(g/b/d)	120.74^{a}	119.89^{a}	123.30^{a}	120.52^{a}	120.17^{a}	115.06^{a}	117.61^{a}	105.40^{b}	1.24	0.058
Feed intake(g/b/d)	239.21^{ab}	243.75^{ab}	263.64^{a}	256.82^{a}	248.30^{ab}	251.41^{ab}	261.36^{a}	230.68^{b}	3.10	0.006
Feed conversion ratio	1.98^{b}	2.04^{ab}	2.14^{ab}	2.13^{ab}	2.07^{ab}	2.20^{a}	2.22^{a}	2.20^{a}	0.02	0.038
Cost of feed/kg diet (Ɛ/kg)	115.70^{a}	114.18^{c}	112.65^{e}	111.13^{g}	115.70^{a}	114.37^{b}	113.04^{d}	111.70^{f}	0.29	0.000
Cost of feed/kg weight gain (Ɛ/kg)	229.21	232.37	240.59	236.82	239.31	252.07	251.37	245.28	2.55	0.846
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000

^{abcdefg} Means on the same row having the different super scripts are significantly different (P<0.05) or blood meal reduced the cost of feed per kg diet at the starter phase of growth. The low performance of turkeys fed blood meal-based diet can be attributed to the imbalance in the amino acid profile leading to low quality of its protein; the heat applied during processing might also have denatured appreciable quantity of the protein. This finding corroborates earlier report by McDonald *et al*., 1992. Low performance of birds fed blood meal-based diets may be attributed to its characteristic offensive smell which may have reduced its palatability, thereby reducing its intake in practical rations for birds. Result in Table 3 shows the interaction of protein source and substitution level irrespective of protein source on apparent nutrient digestibility of turkeys at eight weeks. The result showed significant differences (P<0.05) on all the measurements taken. Highest CPR (78.16% and 79.30%) and Ash (86.80% and 86.49%) were for turkeys fed 20 and 30% substitution level of hydrolysed feather meal for fish meal in that order. The NDF digestibility was lower in turkeys fed 30% substitution level of feather meal or blood meal. The result obtained for nutrient utilization showed that digestibility of nutrient increased as the level of substitution of test ingredient increased. Digestibility rating in this study ranged between 40.56 and 85.19%. According to Alimuddin (2000), digestibility percent rating is good when above 70%; moderate when between 40 and 60% and very low when below 40%. Digestibility of crude protein at the starter phase fell within 70.15% and 77.71% when hydrolysed feather meal was substituted for fish meal in the diets. This means that digestibility of hydrolysed feather meal was enhanced due to processing which involved hydrolysis of keratine probably to its constituent amino acids.

Table 3: Effect of HFM and BLM on the apparent nutrient digestibility of poults (29-56days)

	Replacement levels of test ingredient for fish meal (%)									
	HFM				BLM					
Parameters (%)	**0**	**10**	**20**	**30**	**0**	**10**	**20**	**30**	**SEM**	**P-Value**
Dry matter	61.77^{g}	73.24^{d}	75.80^{c}	81.03^{a}	61.74^{g}	70.12^{f}	71.24^{e}	76.77^{b}	1.66	0.000
CPR	70.14^{d}	76.38^{b}	78.16^{a}	79.30^{a}	70.16^{d}	71.14^{cd}	72.65^{c}	76.12^{b}	0.89	0.003
Crude fibre	71.00^{e}	73.88^{d}	75.83^{cd}	78.29^{b}	71.59^{e}	74.98^{d}	77.42^{bc}	81.52^{a}	0.86	0.009
Ether extract	75.39^{e}	76.26^{d}	77.93^{c}	78.37^{b}	75.582	76.50^{d}	78.48^{b}	79.77^{a}	0.38	0.006
Ash	81.96^{c}	84.83^{ab}	86.80^{a}	86.49^{a}	81.70^{c}	81.52^{c}	83.32^{bc}	83.89^{bc}	0.54	0.018
NFE	59.87^{d}	64.14^{c}	65.92^{b}	68.43^{a}	59.43^{d}	63.98^{c}	67.91^{a}	68.18^{a}	0.87	0.008
NDF	68.01^{b}	66.17^{d}	66.21^{d}	65.34^{e}	68.71^{a}	67.06^{c}	66.19^{d}	65.33^{e}	0.29	0.001
ADF	53.00^{f}	54.05^{e}	57.55^{b}	58.00^{a}	53.83^{e}	54.45^{d}	57.23^{c}	58.19^{a}	0.52	0.001
ADL	40.59^{d}	43.26^{c}	44.74^{b}	50.83^{a}	40.53^{d}	43.11^{c}	44.24^{b}	50.83^{a}	0.98	0.004

$^{abcdefg:}$ Means on the sam e row having the different superscripts are significantly (P<0.05) different , CPR: Crude protein retention, NFE: Nitrogen free extract, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin

It was observed that crude protein digestibility increased with increase in hydrolysed feather meal inclusion at both starter and grower rearing phases of turkey. This trend was also observed by Chiba *et al*. (1996) and Apple *et al*. (2003). The reason adduced to the high digestibility of nutrients in this study may be as a result of the processing method used to produce the feather meal in this study. Moreover, the increase observed in crude protein digestibility suggests that the hydrolysed feather meal may have been broken down into its constituent amino acids. Feather meal utilization has been shown to improve with supplementation with limiting amino acids (Chiba *et al*., 1995). Crude protein digestibility of blood meal in this study was above 70%. This supports the earlier report by Carsten (2004) that crude protein digestibility in blood meal was slightly above 70%. In another study, crude protein digestibility value was reported to be 64% (Edney *et al*., 2005). This variation in digestibility values may be due to certain factors like sources and processing conditions (Han and Parsons, 1991). It is worthy to note that overheating may result in reduced protein quality and decreased digestibility. Data obtained on digestibility in this study revealed that dry matter, crude protein, crude fibre, ash, NFE and ADL increased with age. The reverse trend observed for NDF at the starter phase could be as a result of fish meal acidity which affects NDF digestibility. Digestibility of dry matter, crude protein and ash for feather meal was higher than blood meal at the starter phase. It can be concluded from this study that turkeys could be fed hydrolysed feather meal at 20% inclusion level for higher final weight and weight gain, best feed conversion ratio, lowest feed cost (Ɛ/kg) and feed cost/Kg weight gain. Nutrient digestibility improved as the level of substitution of hydrolysed feather meal and blood meal increased.

Conclusion

It can be concluded from this study that substituting turkey diets with hydrolysed feather meal and blood meal reduced the financial implication of poult diet, while both alternative protein sources (hydrolysed feather meal or blood meal) at 20% inclusion level improved performance, nutrient digestibility and energy metabolisability of starter poults.

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