THE EFFECTS OF PARTIAL REPLACEMENT OF SOYABEAN MEAL WITH BOILED FEATHER MEAL ON THE PERFORMANCE OF BROILER CHICKENS

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Summary

An experiment was conducted using 160 Arbor Acres broiler strain of chickens to evaluate the effects of partial replacement of soyabean meal with feather meal on the diets of broiler chickens raised from day old to 8 weeks of age. Feathers, obtained from a local poultry processing plant, were boiled in water for 30 minutes, sun-dried and ground using a 2 mm sieve for inclusion into the experimental diets at 0, 1.5, 3.0 and 4.5% levels at the expense of soyabean meal. The feather meal was assayed and found to contain 86.5% crude protein and to be low in lysine, methionine and histidine amino acids. The inclusion of such processed feather meal up to 3% in the diet did not ($p > 0.05$) affect growth or feed conversion ratio. However, the highest level of inclusion of feather meal in the diet, 4.5%, significantly reduced both growth rate and feed conversion ratio of the birds. The results of this experiment showed that up to 3% of water-boiled feather meal, which represents 12% of dietary protein, the equivalent of 6% level of use of soyabean meal in the diet, can be successfully included as a protein source in the diets of broiler chickens.

(Key Words : Boiled Feather Meal, Broiler Performance)

Introduction

One of the major factors limiting the development and expansion of the broiler industry in Zambia is the scarcity and high costs of protein feed ingredients (Ochetim et al., 1984). The production of sunflower, cotton and soyabean is still insufficient to satisfy the feedstuff requirements of the country. Groundnut produced in the country is primarily for the confectionery industry. In addition, there is very limited and often erratic availability of protein ingredients of animal origin. However, there are fairly large quantities of feathers available from broiler slaughter houses in the country that are not currently being fully utilised.

Feathers are known to be high in crude protein (Wessels, 1973). However, the availability of the protein in feathers is low due to the keratinised nature of the protein (Moran et al., 1960). The availability of protein from feather meal can be improved by processing (Latshaw and Biggert, 1983). In view of the inadequate production of oilseed crops and the relatively abundant supply of unused feathers in the country, this experiment was designed to test to what extent feather meal could be depended upon in replacing soyabean meal in broiler diets.

Materials and Methods

Feather Processing

Feathers used in the trial were obtained from a local broiler processing plant of Rural Development Corporation in Lusaka. Feathers were boiled in water in a drum for 30 minutes, sun-dried and finely ground to pass through 2 mm sieve.

Diets

Four broiler single stage experimental diets were formulated (tabel 1). The use of a single rather than the conventional two diets, namely broiler starter and broiler finisher was followed as this was the current trend of broiler feeding in the country. The control diet contained no feather meal. This is the practical diet used at

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the University Farm for commercial broiler production. In the other three diets, the processed feather meal, which contained 86.5% protein, was included either at 1.5, 3 or 4.5% at the expense of soyabean meal. All diets were formulated to contain similar protein level, 22% CP, and to be isocaloric, 3,245 kcal/kg of metabolisable energy. Unprocessed feathers were not used in this trial due to the reported adverse effects of such meals on the performance of chickens (Wessels, 1972).

TABLE 1. COMPOSITION OF THE EXPERIMENTAL DIETS

	Diets			
	Level of boiled feather meal (%)			
	0	1.5	3	4.5
Ingredients (%)				
Maize	62.5	64.0	65.5	67.0
Soyabean meal	20.0	17.0	14.0	11.0
Sunflower meal	12.0	12.0	12.0	12.0
Boiled feather meal	0.0	1.5	3.0	4.5
Blood meal	2.0	2.0	2.0	2.0
Dicalcium phosphate	1.5	1.5	1.5	1.5
Limestone	1.2	1.2	1.2	1.2
Salt	0.3	0.3	0.3	0.3
Trace mineral vitamin*	0.5	0.5	0.5	0.5
Protein (N × 6.25) (%) analysed	22.2	22.3	22.3	22.2
Gross energy (Kcal/kg) analysed	4,007	4,010	4,005	4,003
Metabolisable energy (Kcal/kg) calculated	3,046	3,045	3,045	3,046

* Supplied per kilogramme of diet: Mn 50 mg; Cu 8 mg; Zn 40 mg; Se 0.1 mg; Fe 100 mg; Vit A 6,600 IU; Vit D_3 2,200 ICU; Vit E 6.6 IU; Menadione 3.3 mg; Riboflavin 5.5 mg; Niacin 33 mg; Pantothenic acid 8.8 mg; Choline 495 mg; Thiamine 1.1 mg; Pyridoxine 1.1 mg; Vit. B_{12} 0.01 mg; Biotin 0.11 mg; Folacin 0.66 mg; Ethoxyquin 62.5 mg.

Birds and Management

One hundred and sixty one-day old Arbor Acres chicks were obtained from Hybrid Poultry Hatchery in Lusaka. The chicks were randomly divided into sixteen groups consisting of ten chickens each. Four replicate groups were randomly assigned to each of the four dietary treatments. Chicks were housed in pens fitted with electrical heating devices. Heating was discontinued after two weeks. Feed and water were provided on an *ad libitum* basis to each group of ten birds in a pen. Body weights and feed consumption data were obtained on a weekly basis until the termination of the experiment at eight weeks. At eight weeks of age, all the birds were slaughtered and carcass dressed weights and dressing percentages were determined (Ochetim et al. 1984).

Chemical and Statistical Analyses

Feeds and carcasses were analysed for proximate principles (AOAC, 1975) and gross energy using an oxygen parr bomb calorimeter. Amino acid analysis of processed feather meal was determined according to the method described by Niece (1975). All data were subjected to analysis of variance with significant differences determined using Newman-Keuls method at the 5 percent level of probability (Steel and Torrie, 1980).

Results and Discussion

The protein and amino acid composition of the processed feather meal are presented in table 2. As expected, feather meal was found to be high in protein 86.5% but low in methionine, lysine and histidine amino acids. Tryptophan was not determined due to analytical problems.

In agreement with earlier work (Moran et al., 1966; Wessels, 1972) feather meal was found to be high in protein, 86.5%, but distinctly deficient in methionine, lysine and histidine. Although tryptophan was not analysed for due to analytical problems, it may also be correct to assume in line with other work that it too was deficient in the feather meal used (McCasland and Richardson, 1966).

The performance of the experimental chicks during the eight week feeding period is presented in table 3. The inclusion of the processed feather meal up to 3.0% in the diet did not significantly affect mean body weights, feed intake and feed conversion ratio. However, the highest level of inclusion of feather meal, 4.5% level, in the diet significantly reduced final body weight at eight weeks of age. Feed conversion ratio was also adversely ($p < 0.05$) affected at this level of feather meal use.

Carcass data from slaughtered chickens are presented in table 4. Birds fed diets containing 0, 1.5 and 3.0% feather meal had higher ($p < 0.05$) carcass yields compared to those fed the 4.5% feather meal diet. There were no significant differences in dressing percentage between the

TABLE 2. PROTEIN AND AMINO ACID COMPOSITION OF BOILED FEATHER MEAL COMPARED WITH SOYABEAN MEAL

	Feather meal	Soyabean meal
Protein (N × 6.25) (%)	85.6	45.8
Amino acids (mg/16gN)		
Alanine	2.62	1.95
Arginine	4.40	3.16
Aspartic acid	3.42	5.40
Cystine	6.40	0.43
Glutamic acid	6.90	7.53
Glycine	4.20	1.95
Histidine	0.53	1.06
Isoleucine	3.00	2.11
Leucine	5.43	3.46
Lysine	2.26	2.75
Methionine	0.32	0.58
Phenylalanine	3.18	2.26
Proline	6.81	2.28
Serine	5.72	2.76
Threonine	2.47	1.82
Tyrosine	1.79	1.66
Valine	4.13	2.28

TABLE 3. PERFORMANCE OF EXPERIMENTAL CHICKENS AT 8 WEEKS OF AGE

	Diets				SEM*
	Level of boiled feather meal (%)				
	0	1.5	3.0	4.5	
Av. initial wt. (gm)	37	37	37	37	
Av. final weight (kg)	1.82[a]**	1.80[a]	1.76[a]	1.60[b]	0.12
Av. feed intake (kg)	4.20	4.15	4.28	4.39	0.14
Feed conversion ratio	2.33[a]	2.31[a]	2.43[a]	2.74[a]	0.07

* Standard error of dietary treatment means.

** Treatment means with similar or no superscripts within the same column are not significantly different ($p < 0.05$).

TABLE 4. CARCASS DATA ON BIRDS SLAUGHTERED AT 8 WEEKS OF AGE

	Diets				SEM*
	Level of boiled feather meal (%)				
	0	1.5	3.0	4.5	
Av. slaughter weight (kg)	1.82[a]**	1.80[a]	1.76[a]	1.60[b]	0.12
Av. dressed carcass weight (kg)	1.28[a]	1.27[a]	1.24[a]	1.12[b]	0.11
Dressing percentage	70.4	70.6	70.5	70.3	0.03
Carcass protein content (N × 6.25) (%)	21.1	21.0	20.9	20.0	0.72

* Standard error of treatment means.

** Treatment means with similar or no superscripts are not significantly different ($p < 0.05$).

diets. Similarly, there were no significant differences in protein content of the minced carcasses on all the diets. However, carcass protein values obtained at the 4.5% level of feather meal inclusion tended to be numerically lower than those recorded at the 0, 1.5 and 3.0% levels of feather meal feeding.

In general, the weight gain of broilers during the eight weeks was not as high as was exported. Apparently, this appeared to have been due to the very low initial weights of birds at the beginning of the trial. Notwithstanding this shortcoming, there was no reduction in broiler performance with up to 3.0% inclusion of processed feather meal in the diet. However, the 4.5% level of inclusion of feather meal in the diet significantly reduced final body weight and feed conversion ratio. This reduction in broiler performance may be related to amino acid imbalance and the relatively low digestibility and biological value of feather meal. Leucine is higher than isoleucine in feather meal and blood meal as is arginine compared with lysine. This could have led to amino acid imbalance in the feather meal diets and therefore to lower performance. Wessels (1972) found steam processed feather meal to be low in digestibility and biological value. The inherent deficiencies of methionine, lysine, histidine and tryptophan, might well be additional responsible factors for the low biological value of feather meal. However, the high level of cystine in feather meal could have compensated for the low methionine level, except of course for the low digestibility of feather meal. According to Moran et al. (1966), the low digestibility of feather meal is due to the keratinized nature of its protein. Work involving amino acid supplementation is currently going on to find out whether further improvement in broiler performance can be obtained.

Since there were no differences in dressing percentage between the dietary treatments, the observed differences in carcass yields must have been due to differences in final body weights at slaughter time (table 4). It was however of interest to note that although carcass protein content did not differ significantly between the dietary treatments, the value obtained on carcasses from birds fed 4.5% feather meal diet tended to be lower than those recorded on other diets. Further work involving total carcass dissection is underway for further investigation.

Conclusion

The results indicate that feather meal produced by boiling feathers in water can successfully replace the equivalent of up to 6 percent soyabean meal in broiler diets without impairing performance. This level of substitution represents a maximum inclusion rate of 3 percent of processed feather meal in the diet. Secondly, the use of feather meal may also help to broaden the list of protein ingredients that may be used in poultry feeding in Zambia.

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