Research Journal of Biological Sciences 1 (1-4): 32-35, 2006

SAn Evaluation of Hydrolysed Feather Meal as a Protein Source in Rabbit Diets

Bisi Alex Ayanwale
Department of Animal Production, Federal University of Technology,
P.M.B 65., Minna, Nigeria

Abstract: An 8- week feeding trial was conducted to evaluate the utilization of Feather Meal (FM) as a protein source in rabbit diets. A total of 24 weaned rabbits, hybrids of New Zealand White and Black, were used for the work in 4 treatment groups. Four types of feeds containing 0.0 (control), 5.0, 10.0 and 15.0 % FM were formulated and designated T1, T2, T3 and T4, respectively. The 24 weaned rabbits were randomly allotted to each of these diets. There were 6 rabbits in each treatment group and 3 replicates per group with 2 rabbits per replicate. Each replicate has an equal number of male and female rabbits (ratio 1:1). The rabbits were fed on *Luffa aegyptiaca* as forage in addition to the formulated concentrate. The feeding trial lasted for 8 weeks. Proximate and amino analysis of FM were carried out including proximate analysis of *Luffa aegyptiaca.* The results show that FM contains 82 % crude protein and is rich in iron, manganese and zinc and that *Luffa aegyptiaca* has about 16.0 % CP. Rabbits fed the control diet had significantly ($p<0.05$) lower body weight (1085.0 g), weight gain (686.68 g) and daily concentrate intake (66.48 g) per rabbit compared to those fed 15.0 % FM. No significant ($p>0.05$) differences in the intake of luffa among the different treatment groups. Total feed intake (forage + concentrate) was greater (133.84 g) in the control than in 15 % FM-fed rabbits. It was concluded that rabbits could be fed on feather meal up to 15% level with improved performance.

Key words: Evaluation, hydrolysed, feather meal, protein source, rabbit diets

INTRODUCTION

Rabbit (*Oryctolagus cunniculus*) is an important source of animal protein for many nations Cheeke,[1]. Production of rabbits can reduce the eminence animal protein shortage of the developing world. Some of the common feedstuffs in use as major protein sources in animal diets include soyabean meal, groundnut cake, fish meal and palm kernel cake. However, Fuller[2] reported that poultry feather, a waste product from poultry industry, is efficiently consumed by broilers as a supplement or total substitute of their major protein when processed into meal. The practice of feeding Feather Meal (FM) to broilers has not gained wide spread acceptance due to inability of broilers to utilize the protein of the Feather Meal (FM) because of its keratin content. Rabbits however, possess the ability to utilize a wide range of agro-industrial by-products Omole[3] and table scraps Shqueir,[4]. This potential has not been fully exploited in rabbit production.

Feather Meal (FM) is a by-product resulting from treatment under pressure of clean, undecomposed feathers from slaughtered poultry birds and is free of additives. It is a total waste product from the production of poultry meat. There are over one million tons of feather produced in United States and African countries. As the consumption of poultry meat increases so will the production of feather continue to increase. There is therefore the need to find an economic use of this waste product, particularly in the developing countries where animals are facing stiff competition with their owners for the little available conventional feed ingredients such as maize, sorghum, millet and others. Rabbit production is a major means of achieving this aim. Feather Meal (FM) is high in protein containing well over 82 % crude Protein Cullison and Lowrey[5] and is over 75 % digestible if well processed. Feather does not suffer from the disadvantages of anti- nutritional factors AAFCO[6] like tannins, gluscosinolates, lectins and trypsin inhibiting factors Ewing[7]. These create the obvious need for the potentials of FM to be fully exploited in rabbit feeding. Therefore Cullison and Lowrey[5] and Kellems[8] stated that FM is used primarily in swine and poultry feeds and its use is limited to only about 2.5% because of its low content of certain essential amino acids. This deficiency does not put FM at any disadvantage for its use in rabbit diets. This is because rabbits can obtain the limiting amino acids from forage crops. Other workers Naber

Table 1:Composition of experimental concentrate mixture fed to the experimental rabbits

Ingredients	Feather T1	meal T2	levels T3	%T4
Yellow maize	55.00	55.00	55.00	55.00
Groundnut cake	28.00	23.00	18.00	13.00
Feather meal	0.00	5.00	10.00	15.00
Corn bran	10.25	10.25	10.25	10.25
Oyster shell	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
*Premix	0.25	0.25	0.25	0.25
	100.00	100.00	100.00	100.00

* Premix to supply the following per kg of diet:Vit.A, 1200iu; Vit. D 2500; Vit. E 10iu; Vit.K,1.5 mg; Vit.B1, 2.5 mg Vit.B2 5mg; Vit.B6, 4mg; Vit. B12, 0.02 mg; Biotin, 0.2 mg; Fe, 50 mg; Mn, 150 mg; Cu, 2.5 mg; Zn, 45 mg; Co,0.2 mg; Se, 0.08 mg; I, 1.4 mg, Ca pantothenate, 10 mg; Choline chloride, 500 mg

Table 2: Composition of the experimental concentrate mixture on as-fed bases (%)

Ingredients:	Yellow maize	Groundnut cake	Feather meal	Corn bran	Oyster shell	Meal	BoneSalt	Premix
Concentrate mixture								
1(Control)	55.00	28.00	---	10.25	4.00	2.00	0.50	0.25
2	55.00	23.00	5.00	10.25	4.00	2.00	0.50	0.25
3	55.00	18.00	10.00	10.25	4.00	2.00	0.50	0.25
4	55.00	13.00	15.00	10.25	4.00	2.00	0.50	0.25

* Premix to supply the following per kg of diet: Vit.A, 1200iu; Vit. D 2500; Vit. E 10iu; Vit.K,1.5 mg; Vit.B1, 2.5 mg Vit.B2 5 mg; Vit.B6, 4 mg; Vit. B12, 0.02 mg; Biotin, 0.2 mg; Fe, 50 mg; Mn, 150 mg; Cu, 2.5 mg; Zn, 45 mg; Co,0.2 mg; Se, 0.08 mg; I, 1.4 mg, Ca pantothenate, 10 mg; Choline chloride, 500 mg

et al.[9]; Summers[10]; McDonald *et al.*[11] have worked on the effect of FM on swine, ducklings, layers, sows and growing-finishing pigs. This study was therefore designed to evaluate the utilization of hydrolysed poultry feather meal as a protein source in rabbit diets.

MATERIALS AND METHODS

A total of 24 rabbits (12 males and 12 females) were used for this work. Their average age was 6 weeks. They were the product of the cross between New Zealand White and New Zealand Black. They were randomly assigned to 4 treatment groups in 3 replicates. Each treatment group had 6 rabbits with 2 rabbits per replicate.

Housing: The rabbits were raised in a stable that contained rabbit hutches. The hutches were constructed of wire mesh and hard wood on the floor. The sides of the hutches were made of wire mesh for proper ventilation. The stable was roofed with galvanized iron and floor made of concrete materials. Provisions were made on the hutches for both feeders and drinkers which were firmly attached to the lower part of the hutches for easy reach of the rabbits.

Feeding trial: The feeding trial lasted for 8 weeks. The rabbits were given both *Luffa aegyptiaca* as forage and a concentrate mixture which comprises of maize, groundnut cake, corn bran, oyster shell, salt and premix (Table 1). The Feather Meal (FM) was incorporated into the mixture at the rate of 0.0, 5.0, 10.0 and 15.0 % for treatment groups T1, T2, T3 and T4, respectively.

Parameters measured: The parameters measured include average weekly body weight, weight gain, concentrate and forage intake, mineral and amino acid composition of the feathers. The concentrates were given during the day time while *Luffa aegyptiaca* leaves were given *ad-libitum* during the night time.

Feather meal preparation: Feather meal was prepared by boiling clean fresh feathers in a medium size pressure cooker to a temperature of 140°C for 60 min. This heating is necessary to make feather easy to crush and probably improve its digestibility so as to make its nutrients available to the rabbits. The boiled feather was sun-dried and then crushed using an electric motor grinder. The FM was used along with other ingredients to produce the concentrate mixture (Table 2).

Cemical analysis: The proximate composition (ether extract, crude fibre, ash, dry matter) of the ground ingredients and experimental diets were done according to the procedures of A.O.A.C.[12]. Amino acid analysis of the feathers was done by the method of Spackman *et al.*,[13]. Minerals in the feathers were determined from a wet nitric acid digest using atomic absorption spectrophotometer (AAS) but phosphorus was determined colorimetrically using the vanadomolybdate reagent. Sodium and potassium were determined by flame photometry A.O.A.C.[12].

Data analysis: The data collected were subjected to analysis of variance. The means were separated according to Duncan[14] methods where there were significant differences.

RESULTS AND DISCUSSION

The chemical composition of the feather meal is presented in Table 3. The values indicated for FM agree with those given by Ewing[7] . The results show that FM is rich in protein and Dry Matter (DM) but low in Crude Fibre (CF). The CF of Luffa is higher than that of FM. The high CF of Luffa is good for the rabbits which requires about 15 % CF. The mineral composition of the feather meal is presented in Table 4. The values agree with the report of NRC[15]. The results indicate that FM is particularly rich in iron (Fe), zinc (Zn) and manganese (Mn).

Table 3: Chemical Composition of feather meal and *Luffa aegyptiaca* fed to the rabbits

Components	Feather meal	*Luffa aegyptiaca*
Dry matter	90.00	74.52
Crude protein	82.00	16.00
Ether extract	6.10	2.75
Ash	4.20	6.00
Crude fibre	0.60	12.00
Available lysine	1.70	_
Methionine +cystine	4.80	_
Metabolisable energy (kcal g^{-1})	3.07	2.08

Table 4: Mineral Composition of feather fed to the experimental weaned rabbits (g kg^{-1})

Minerals	Values
Calcium	0.35
Phosphorus	0.56
Magnesium	0.17
Potassium	0.25
Sodium	0.60
Iron	74.00
Manganese	12.00
Zinc	58.0

Table 5: Amino acid Composition of feather meal (mg $100g^{-1}$)

Amino acid	Values
Lysine	1.96
Methionine + cystein	4.80
Cystine	3.35
Threonine	4.05
Tryptophan	0.50
Isoleucine	4.15
Leucine	6.95
Valine	4.20
Histidine	0.80
Arginine	6.50
Serine	9.65
Phenylalanine	3.90
Tyrosine	2.25

The results presented in Table 5 is the amino acid composition of the FM used for feeding the rabbits. The amino acid composition is in consonant with the values given by NRC[15].

Table 5 shows that FM is deficient in tryptophan and histidine but rich in serine, arginine and leucine. The performance of rabbits fed hydrolysed poultry FM is shown in Table 6. The results indicate that body weight gain and final body weight of the rabbits were improved ($p < 0.05$) by FM compared to the control. The weight gain was significantly ($p<0.0\%$) lower in the control rabbits than FM - fed rabbits. These were attributed to the effect of thermal hydrolysis on the keratin of the poultry feather. Keratin is a protein and is rich in amino acid cystine. On thermal hydrolysis the cross linkage between the cystine and methionine are broken which makes the crude protein available to the rabbits for utilization.

The mean concentrate intake (g/day/ rabbit) decreased as the level of FM in the diets increased while the level of forage (*Luffa aegyptiaca*) increased. Rabbits fed the control diet consumed more forage and less concentrate compared to those fed FM diets. This could be due to low palatability of dietary FM. According to Klopfenstein[16] the controlled technology of steam hydrolysation is capable of converting a relatively insoluble protein to a palatable protein source.

The Crude Fibre (CF) intake increased as the level of forage intake increased and the consumption is within the recommended levels for rabbits as Heckmanand Mehner[17] reported that 8-9 % CF gave greater gains for animals than other levels tested in their work. Also, National Research Council NRC[15] recommended CF levels of 10- 20% for rabbits while Cheeke[18] reported that CF above 17% depressed growth rate by restricting energy intake. The crude protein intake is also within the recommended levels. NRC[15] recommended 16% CP while Ijaiya[19] recommended 16-20% CP for rabbits raised under the tropical environment. The dietary combinations of FM

Table 6: Performance characteristics of rabbits fed feather meal based diets

Parameters	T1	T2	T3	T4	SEM
Mean initial body weight (g)	398.32	411.66	418.33	418.22	2.49
Mean final body weight(g)	1085.00b	1105.00a	1160.00a	1168.00a	3.48*
Mean body weight gain (g)	686.68b	693.34ab	741.67a	759.78a	5.12
Mean Concentrate intake(g)/day/ rabbit	66.48a	54.35ab	49.92b	44.99b	2.94*
Mean forage intake (g)/day/rabbit	67.36	69.74	69.97	70.30	0.61
Mean feed intake (g)(concentrate+forage)/day)	133.84a	124.09ab	119.89ab	115.29b	2.95*
Mean crude protein (g)/day/ rabbit	10.78b	15.26ab	19.40a	23.55a	1.73*
Mean crude fibre intake (g)/ day/ rabbit	8.39b	11.40a	14.45a	17.48a	1.69*

Means denoted by the same alphabet in the same row are not significantly ($p>0.05$) different. SEM: Standard error of mean. * significant difference

and *Luffa aegyptiaca* can be used to produce rabbits optimally with minimum cost. This is because poultry feather is a waste product of poultry slaughter industry and *Luffa aegyptiaca* is a nuisance weed to farmers and other environmentalists.

CONCLUSION

Feather meal at 5-15% level can be used successfully to serve as a dietary source of protein and to provide the necessary amino acids in rabbits diets. The performance of such rabbits is enhanced when the feather meal is fed in combination with a forage such as *Luffa aegyptiaca.*

ACKNOWLEDGEMENTS

The author is indebted to Agbola Morounfolu Oluseyi and Asiyanbola Dare Isaac for helping in collecting part of the data for this study.

REFERENCES

1. Cheeke, P.R., 1980. The potential role of rabbit in meeting World Food needs. J. Applied Rabbit Res., 3: 3-12.
2. Fuller, H.L., 1967. Performance Characteristics of broilers fed feather meal contained diet. Proceedings of 1967Georgia Nutrition Conference, pp: 24.
3. Omole, T., 1982. The effect of dietary protein on growth and reproductive performance of rabbits. J. Appl. Rabbit Res., 5: 83-85.
4. Shiqueir, A.A., 1985. Effect of feeding cabbage residue on performance and diatichea in rabbits. J. Appl. Rabbit Res., 8: 177-180.
5. Cullison, A.E. and R.S. Lowrey, 1987. Feeds and Feeding, 4th Ed. A Reston Bk. Prentice Hall, Inc. Engel Wood Cliff, N.J. pp: 54-57.
6. A.A.F.C.O, 1999. American Association of Feed Control Official. Feather meal and its nutritional uses No. 12. Nutrient requirement of cattle.
7. Ewing, W.N., 1997. The feed directory. Published by Context, United Kingdom.
8. Kellems, A.C., 2000. The composition of feather meal and its nutritional importance. Poultry Sci., pp: 67-3367.
9. Naber, E.E., S.P. Touchburn, B.D. Barnett and C.L. Morgan, 1961. Effect graded levels of dietary protein on broilers. Poultry Sci., pp: 40-1234.
10. Summers, J.D., 1969. Feedstuffs. Animal Science publication, www.wattpoultry.net., pp: 16-36.
11. Mc Donald, E.A., C.A. Edwards, M. Greenhalgh and C. Morgan, 1999. Animal Nutrition, 5th Edn. The interstate Printing and Publisher, Daville, Illinois, U.S.A., pp: 534.
12. A.O.A.C, 2000. Association of Official Analytical Chemists. Official Methods of Analysis, 17th Ed. Washington, D.C.
13. Spackman, D.H., E.H. Stein and S. Moore, 1980. Automic recording apparatus for use in Chromatography of amino acids. Analytical Chemistry, 30: 1190-1191.
14. Duncan, D.B., 1955. Multiple range and multiple F-tests. Biometrics, 11: 1-42.
15. N.R.C., 1981. National Research Council. Nutrient requirement of domestic Animals, Nutrient requirement of rabbits, pp: 9.
16. Klopfenstein, T., 1990. Director's digest. Fats and protein Research Foundation, pp: 177.
17. Heckmann, F.W. and A.V. Mehner, 1977. Protein and Crude fibre content of mixed feed for fattening young rabbits. Nutrition Abstract And Review, pp: 49-299.
18. Cheeke, P.R., 1987. Rabbit Feeding and Nutrition. Orlando Academy Press 1st Ed. Daville illnois.
19. Ijaiya, A.T., 1995. Growth and Carcass characteristics of rabbits fed graded levels of dietary protein. M. Tech. thesis, Federal University of Technology, Minna; Nigeria, pp: 150.