THE EFFECTS OF BROILER LITTER AS PROTEIN SOURCE ON THE PERFORMANCE OF BUNAJI (WHITE FULANI) BULL CALVES

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ABSTRACT

Effect on voluntary feed intake and digestibility when growing cattle consuming forage were supplemented with autoclaved broiler litter (ABL) was investigated. Four, 8-11 months old Bunaji bull calves (82.20kg mean initial BW) in a 4 x 4 Latin square with 21-d periods consuming *Panicum maximum* hay *ad libitum* were randomly allotted to treatments. Concentrate supplement treatments were A (Control, no ABL), B (20%), C (40%) and D (60%) ABL levels respectively. Calves consumed an average of 1882.25g DM, 165.45g CP from the sole hay ration. As ABL inclusion increased in the concentrated diets, mean intake of crude protein (CP), crude fibre (CF), acid detergent fibre (ADF), neutral detergent fibre (NDF), and detergent fibre (ADF, neutral detergent fibre (NDF) and cellulose increased but that of EE decreased significantly ($P < 0.01$). The digestibilities of the DM, CP, CF, ADF, NDF and cellulose of ration A that contained the highest CW (98%) and the least CP (5.14%) were significantly lower ($P < 0.01$) than those of ABL based rations B to D. Liveweight gain was greatest ($P < 0.05$) for rations D. Gain:DM intake was greater with ABL than without (0.07, 0.40, 0.16 and 0.17 for control A, B, C, and D diets respectively). The MFN : FN ratio declined as dietary nitrogen level increased. The results emphasised the need to supplement the feeding of Bunaji cattle with a concentrate diet that might simply consist of a combination of cassava wastes meal (CWM) and autoclaved broiler litter (ABL), the best of which was shown in this study to be 60% ABL and 38% CWM offered *ad libitum*.

Key words: Broiler litter, cassava waste meal, feed intake, digestibility. White Fulani.

INTRODUCTION

Intensive livestock production in recent years has complicated the process of disposal of animal excreta. Scientists are therefore focussing their attention on finding new ways of animal manure disposal. Their attention was stimulated by finding ways of reducing environmental pollution, reduction in competition for grains between livestock and man and uses of animal excreta in the formulation of moderate protein and energy rations as supplements to low protein and energy animal diets found in developing countries.

The efficiency of utilizing dried poultry waste as livestock feed has been demonstrated by numerous workers (Smith *et al*, 1976; Muller, 1974; Blair, 1975 and Park, *et al* 1995). Results indicate a considerable variation in quality, depending largely on type of bedding and on ash contents. Availability of nitrogen and phosphorus is considerably high while the energy content is low (FAO, 1980). Reduction of energy content resulting from the substitution of a part of a ration with broiler litter (BL) may be compensated for by integrating wastes from fruits, vegetables, stem or root tubers (FAO, 1980). This improves the palatability, feed intake and maximum utilization of the NPN fraction of broiler litter. The digestible energy concentration of the litter is similar to that of medium to high quality roughage (Fontenot and Jurubescu, 1980) Ruffin and McCaskey (1990) reported various sources of energy in litter to include undigested dietary constituents, nitrogen containing waste products of poultry metabolism, microbial cells and bedding, proportion of which vary with the production conditions. The present experiment was therefore designed to investigate the effect of broiler litter based diets on nutrient intake and

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digestibility by Bunaji Bull Calves.

MATERIALS AND METHODS

Diet preparation and feeding.

The broiler litter (containing wood shavings as bedding) used for the experiment was sundried for about one week, milled and autoclaved at a temperature of 121°C under steam pressure of 15kg/cm² for 15 minutes. Four experimental diets were formulated with the relative proportion (W/W) of the ingredients shown in Table 1. Except for the control diet A, the other diets B and D were formulated to contain increasing levels (20, 40 and 60% respectively) of broiler litter at the expense of cassava wastes. The concentrate diets were fed at 3% of the liveweight of each animal separately but simultaneously as supplement to the forage diet which was fed *ad libitum*.

& Lyloyd (1959). During the total faecal collection period, the hay and concentrates rejected after a 24-hour feeding period were collected daily. These were bulked at the end of the collection period and oven dried. Daily total faecal output of each harnessed animal during the collection period was collected, accurately weighed, mixed well manually and aliquot taken for subsequent analysis. One faecal subsample each from different animals was used to determine the dry matter content of the faeces in a thermostatically controlled electric oven at 105-110°C for 48 hours.

The animals were weighed at the beginning and at the end of each collection period. During the digestibility trials, the intake and digestibility of nutrients cellulose and energy of all the diets were determined.

TABLE 1 COMPOSITION OF THE EXPERIMENTAL DIETS

Ingredients %	DIETS			
	A	B	C	D
Cassava wastes	98.00	78.00	58.00	38.00
Autoclaved broiler litter	0.00	20.00	40.00	60.00
*Vitamin-mineral premix	1.00	1.00	1.00	1.00
Common salt	1.00	1.00	1.00	1.00
	100.00	100.00	100.00	100.00

*Containing per kg: Vit. A, 800,000 i.u.; Vit. D₃, 1,500,000 i.u.; Vit. E, 3000 i.u.; Vit. K₃, 300g; Vit. B₂, 250g; Nicotinic acid, 8.00g; Calcium D-Pantothenate, 30g; Vit. B₆, 0.30g; Vit. B₁₂, 8.00mg; Manganese, 10.00g; Iron, 5.00g; Zinc, 4.50g; Copper, 0.20g; Iodine, 0.15g; Cobalt, 0.02g and Selenium, 0.01g.

Digestibility trials

A 4 x 4 latin square design was used to study the digestibility of the dry matter (DM) and nutrients of the four experimental concentrate diets using four, 8-11 months old Bunaji (White fulani) bull calves (82.20kg mean initial body weight). There were four trial periods that lasted for 21 days each and a change over period of seven days between any two periods. All the experimental animals were first fed only the basal diet (*Panicum maximum*, Jacq) hay *ad libitum* for a 14-day adjustment and preliminary period followed by a 7-day total faecal collection period to determine the digestibility coefficients of the dry matter and nutrients of the concentrate were calculated by the equation of Crumpton

Laboratory analysis.

Samples of feeds, faeces and orts were analysed for the proximate composition according to the methods prescribed by A.O.A.C. (1970). Acid detergent fibre (ADF), neutral detergent fibre (NDF) and lignin were determined by the analytical procedure of VanSoest (1963). The gross energy contents of each feed, ort and faeces were determined using a Gallenkamp ballistic bomb calorimeter (Model CB-370).

Statistical analysis.

Analysis of variance (Steel and Torrie, 1960) of the data collected was used to determine any significant differences among the parameters studied. Where significant differences were observed, means were further

subjected to Duncan's multiple range test (Duncan, 1955).

RESULTS

The chemical compositions of hay, cassava wastes, autoclaved broiler litter and of the diets are shown in Table 2. With the exception of ether extract, nitrogen free extract and energy contents, incorporation of cassava waste with broiler litter (W/W) in concentrate diets B-D improved the chemical composition as compared with control diet A (Table 2). The crude protein and crude fibre contents increased by 6.92 and 2.88% respectively while, the energy content declined (1.54%) as broiler litter inclusion increased from 0 to 60%.

Table 3 shows the mean liveweight and dry matter intake of the hay and rations A-D. Feed refusals were small and not frequent, mean daily dry matter intake from the sole hay rations were 1882.25 ± 0.09 g dry matter and 165.45 ± 8.16 g crude protein. There was no

liveweight basis, the hay intake alone was the least consumed while ration D was the least consumed among the broiler litter based concentrate diets. Table 4 lists the nutrient intake and apparent digestion coefficients of the components of the concentrate diets. As the dietary broiler litter increased, the mean intake (g/day or g/day/W^{0.75}) of crude protein, crude fibre, acid detergent fibre, neutral detergent fibre and cellulose of the concentrate diets and the total rations increased significantly ($P < 0.01$) while that of ether extract (Total ration) decreased ($P > 0.05$).

With the exception of the energy digestibility for supplements containing litter which did not differ from that of the control, the results showed that the inclusion of litter in diets B-D significantly increased the digestibility coefficient of DM, CP, CF, ADF, NDF and cellulose compared with diet A that had no litter ($P < 0.01$). Ether extract

TABLE 2: PROXIMATE COMPOSITION OF THE DIETS AND FEED (DRY MATTER BASIS)

Parameters%	A	Diets		D	Feeds		Guinea Grass hay
		B	C		Cassava Waste	Auto claved broiler Litter	
Dry matter	84.08	90.00	92.00	87.70	91.30	86.00	80.45
Crude protein	5.14	6.99	9.76	12.06	4.72	18.40	8.79
Crude fibre	12.58	13.26	13.86	15.46	11.56	24.66	31.00
Ether extract	1.20	0.74	0.76	0.53	1.10	1.33	1.41
Nitrogen free extract	76.32	72.32	54.98	50.05	78.25	35.29	50.89
Ash	4.76	6.67	20.63	21.91	4.37	20.32	7.90
Gross energy (kcal/g)	5.43	4.77	4.06	3.89	5.42	3.21	3.46
Acid detergent fibre	23.75	50.00	57.87	60.00	24.30	35.87	35.13
Neutral detergent fibre	35.35	59.78	59.98	63.67	34.90	68.30	66.70
Cellulose	15.32	39.78	48.21	52.21	15.30	30.25	28.40
Lignin	8.33	9.46	9.46	6.55	8.41	4.12	5.71
Insoluble ash	0.10	0.76	0.20	1.24	0.59	1.50	1.02

significant difference in the actual intake (g/day) of dry matter and nutrients from hay alone and hay content of rations A- D Bunaji calves. When DM intake was expressed on

digestibility decreased as broiler litter substitution increased. The digestibility coefficient of nitrogen free extract, acid detergent fibre and neutral detergent fibre of

TABLE 3: MEAN LIVEWEIGHT AND DRY MATTER INTAKE OF HAY AND RATIONS A-D BY BUNAJI BULL CALVES DURING DIGESTIBILITY TRIAL

Parameters	Grass	Ration A	Ration B	Ration C	Ration D	±SE
Mean weight (kg)	63.07 ^a	90.02 ^b	78.86 ^c	78.83 ^c	100.19 ^d	±3.50*
Metabolic weight W ^{0.75} kg	22.38 ^a	29.22 ^b	26.46 ^c	26.46 ^c	31.67 ^b	±1.30
Weight gain (g/d)	110.20 ^a	300.11 ^b	413.26 ^c	648.12 ^d	732.50 ^e	±21.10*
Concentrate DMI g/day/W ^{0.75} kg	-	70.84 ^a	74.36 ^a	75.68 ^a	83.57 ^b	±2.90
Total DMI (g/day/W ^{0.75} kg)	84.10 ^a	145.52 ^b	154.20 ^b	157.97 ^c	134.34 ^d	±5.20**
DMI as % of initial live weight)	3.5 ^a	4.74 ^b	5.20 ^c	5.38 ^c	4.30 ^d	±0.43*
DMI (% of Body weight)	2.98 ^a	4.72 ^b	5.17 ^c	5.30 ^c	4.27 ^b	±0.40**
	(100%)	(158.4%)	(173.5%)	(177.9%)	(177.9%)	(143.3%)
Gain: DM	0.06	0.07	0.10	0.16	0.17	

Means with different superscripts in each row are significantly different from each other ($P < 0.05$), (* $P < 0.05$ ** $P < 0.01$)

TABLE 4 NUTRIENT INTAKE AND DIGESTIBILITY OF BROILER LITTER-BASED DIET BY BUNAJI BULL CALVES DURING DIGESTION TRIAL

Components	A	B	Diets C	D	Standard error
Nutrient intake (g/day/W ^{0.75})					
Concentrate CP	3.64 ^a	5.20 ^a	7.39 ^b	10.08 ^a	±0.56**
Total CP	13.01 ^a	12.22 ^a	14.62 ^b	16.03 ^c	±0.60**
Concentrate CF	8.91 ^a	9.86 ^a	10.50 ^a	12.92 ^b	±0.86**
Total CF	40.88 ^a	34.61 ^b	36.01 ^c	33.91 ^b	±1.44**
Concentrate EE	2.45	1.69	1.72	1.41	±0.01ns
Concentrate ADF	16.83 ^a	37.18 ^b	43.80 ^{bc}	53.21 ^c	±4.14**
Total ADF	34.90 ^a	65.23 ^b	72.71 ^c	73.93 ^c	±4.50**
Concentrate NDF	25.04 ^a	44.45 ^b	45.39 ^b	50.14 ^b	±2.92**
Total NDF	95.44 ^a	97.82 ^a	100.28 ^b	98.38 ^{ab}	±5.57**
Concentrate Cellulose	10.85 ^a	29.58 ^b	36.49 ^{bc}	43.63 ^c	±2.39**
Total Cellulose	40.88 ^a	52.55 ^b	59.86 ^{bc}	62.86 ^c	±4.54**
Concentrate energy	394.67	354.69	307.26	325.08	±35.89ns
Total energy	819.88	630.92	592.00	559.39	±40.83ns
Metabolic Faecal Nitrogen (g/kg)	11.43	10.95	10.48	9.95	±0.90ns
Concentrate Nutrient digestibility, %					
DM	67.99 ^a	82.44 ^b	78.07 ^b	83.94 ^b	±1.49**
CP	33.54 ^a	54.65 ^b	67.77 ^b	67.19 ^b	±3.97**
CF	44.81 ^a	55.64 ^b	52.36 ^b	68.92 ^c	±2.74*
EE	75.54 ^a	58.10 ^{ab}	57.55 ^{ab}	46.25 ^b	±5.79*
NFE	69.54 ^{ac}	78.13 ^b	75.02 ^{ab}	63.31 ^c	±2.01**
ADF	35.49 ^a	51.94 ^b	63.66 ^c	55.73 ^{bc}	±2.46**
NDF	17.68 ^a	57.25 ^b	71.18 ^c	67.46 ^{bc}	±3.49**
Cellulose	13.71 ^a	40.82 ^b	49.55 ^c	52.28 ^c	±1.23**
Energy	57.50	67.41	58.01	64.95	±4.94ns

Means with different superscripts in each row are significantly different from each other ($P < 0.05$) (* $P < 0.05$ ** $P < 0.01$) ns = not significant

diet A were significantly lower ($P < 0.01$) than the values recorded for diets C and D. It was observed that the metabolic faecal nitrogen apparently decreased (11.43-9.95 g/kg) as the crude protein content of the diets (A-D) increased (Table 4).

DISCUSSION

The bulls derived a virtually constant proportion of their total dry matter intake from the concentrate components of rations A to C but from ration D (Table 3). They, however, consumed increasing proportions of their protein, ADF and energy from concentrate diets. The declining energy: protein ratio 63.0:1, 51.6:1, 40.5:1 and 34.9:1 of total intake from ratio A, B, C and d respectively was apparently responsible. The bull calves consumed approximately 3% of their body weight as dry matter from the sole hay ration. When the hay was supplemented with concentrate diets A - D, the dry matter consumed was 4.3 to 5.3% of live weight of the calves (Table 3). This might be due to the generous feeding of the ration to the animals and suggested that tropical cattle breeds are capable of consuming a higher percentage of their body weight as dry matter than hitherto reported by Adebowale (1976) and Apori (1988). However, the higher dry matter consumed was not totally wasted but used by the animals for increasing live weight gain since young animal need more nutrients to be able to grow (NRC, 1978).

The addition of autoclaved broiler litter-based concentrate diet to the basal diet of *Panicum maximum* hay had practical effect intake of hay. Hence, dry matter intake relative to body weight was between 43 and 78% higher for ABL supplemented hay than on non supplemented hay (Table 3). The results suggested that, when *Panicum maximum* hay was supplemented with concentrate diets in which increasing broiler litter levels was substituted for cassava wastes, approximately half of the total DMI from the ration would be selectively consumed from either the forage or concentrate diets.

The apparent digestion coefficients of the

proximate components of the diets obtained in this study were comparable to those reported in literature (Harmon *et al.*; 1975; Park *et al.*, 1993). The improved digestion of EE could be attributed to the concentration of ether extract in diet A (Table 1) when compared with other diets (B-D). Increasing digestion of crude fibre and cellulose as dietary broiler litter level increased agreed with the work of Bhattacharya and Fontenot (1966). In this study poor protein diet showed poor protein intake and digestibility.

The decrease in the ratio of metabolic faecal nitrogen (MFN) to faecal nitrogen as the nitrogen content of the diet and the CP digestibility increased agreed with the finding of Ranjhan (1980). Cassava waste is known to contain readily fermentable carbohydrate. Their supplementation with broiler litter based diet might have changed the degree of rumen fermentation to an appreciable extent and resulted in remarkable changes in the digestibilities of dry matter and other nutrients except energy content. This suggested that supplementation of readily fermentable carbohydrate source to broiler litter based diet in Bunaji cattle ration will ensure efficient utilization by rumen microbes of the NPN present in the litter which could apparently improve the digestibility of the diet constituents (FAO, 1980).

The proximate components of diets C and D which were apparently best digested among the diets suggested that inclusion of 40 and 60% broiler litter and 38 to 58% cassava wastes in concentrate diets for Bunaji cattle would encourage the optimal rumen environment for maximum degradation of the feed constituents, while the poor digestion of diet A could be attributed, to unfavourable rumen environment for the microbes due to low crude protein content of the diet.

The complementary effect of readily fermentable carbohydrate (cassava waste) in the diets encouraged the inclusion of the litter up to 60% level (as against 40% level recommended by FAO, 1980) without any deleterious effect on intake and digestibility of the nutrients. The inclusion of cassava wastes

in the diets used in this study enhanced the energy levels of the tested diets. This is in support of various reports in literature (Aregheore, 1982; Adegbola and Asaolu, 1986). The result of this experiment showed that improvement in the intake and digestibility of nutrients of broiler litter based diet is a good indication of the potential utilization of the litter in the diet of Bunaji (White Fulani) cattle provided a source of readily fermentable carbohydrate is supplemented.

REFERENCES

- ADEBOWALE, E. A. (1976) Studies on dry matter, energy and protein utilization of three breeds of dairy cows at Ibadan. Ph.D Thesis, University of Ibadan, Ibadan.
- ADEGBOLA, A. A. and ASAOLU, V. O. (1986). Preparation of cassava peels for use in small ruminant production in Western Nigeria. In Preston, T.R. and Nuwayyaka, M.Y. (eds). Proceeding of a Workshop held at the University of Alexandria, Egypt. October. 1985 ILCA, Addis Ababa, Ethiopia. pp. 109-115.
- A.O.A.C. (1970). Official methods of analysis. Association of Official Analytical Chemists. 11th ed., 16.041 method. Washington, D.C.
- APORI, S. O. (1988). Replacement value of yam peels for maize in the diet of White Fulani cattle. Ph.D Thesis, University of Ibadan, Ibadan.
- AREGHEORE, E.M. (1982). Effect of replacement of the concentrate ration by graded levels of cassava peels on the performance of dairy calves (Brown Swiss x N'dama). M.Sc (unpublished) Thesis, Dept. of Animal Science, University of Ibadan, Ibadan.
- BHATTACHARYA, A.N. and FONTENOT, J.P. (1966). Protein and energy value of peanut hull and wood shaving poultry litter. *J. Anim. Sci.* 25: 367-371.
- BHATTACHARYA, A.N. and FONTENOT, J.P. (1965). Utilization of different levels of poultry litter nitrogen by sheep. *J. Anim. Sci.* 24 (4): 1174-1177.
- BLAIR, R. (1975) Utilizing waste in Animal feed A European overview. *Feedstuff*. June 30: 16.
- BRUGMAN, H.H., DICKEY, H.C., PLUMMER, B.E. and POULTON, B.R. (1964) Digestibility of sterilized poultry litter. *J. Anim. Sci.* 26:915 (Abstr).
- CRAMPTON, E.W. and LLOYD, L. E. (1959) *Fundamentals of Nutrition*, Freeman, H.M. and Co. San Francisco and London.
- CULLISON, A. E., McCAMPBELL, H.C., CUNNINGHAM, A.C., L'WREY, R.S., WARREN, e.P., MCLENDON, B.D. and SHERWOOD, D. H (1976) Use of poultry manure in steer finishing rations. *J. Anim. Sci.* 42: 219.
- DUNCAN, D.B. (1955) Multiple range and multiple F-test. *Biometrics* 11: 1-42.
- F. A. O. (1980) Food and Agricultural Organization. Feed from animal wastes. States of knowledge vol. 18. FAO. Rome.
- FONTENOT, J. P. and JURUBESCU, V. (1980) Processing of Animal waste by feeding to ruminants. In: Y. Ruckebusch and P. Thivend (Editors). *Digestive Physiology and Metabolism in Ruminants*. AV1, Westport, CT, pp 641-662.
- GAMOVSKI, K.H. and IVANOU, I.G. (1982). The protein: carbohydrate ratio in diets and its effect on the digestive process in sheep. *Veterinar-nomeditsinski Nauki* 19:111-116
- HARMON, B.W., FONTENOT, J.P., WEBB, K.E. Jr (1975). Ensiled broiler litter and corn forage. 11. Digestibility, nitrogen utilization and palatability by sheep. *J. Anim. Sci.* 40: 144-155.
- MULLER, Z. (1974) Summary of work, conclusions and recommendations on animal nutrition, feeding and utilization of by-product and waste in Singapore. UNDP/FAO Rep. AGA; SF/SIN 5. Nut R- 104.
- N.R.C. (1978) Nutrient Requirement of Dairy cattle 6th Rev. Ed., Natl. Res. Council. Natl. Acad. Sci. Washington, D.C.
- PARK, K. K., GOETCH, A. L., PATIL, A. R., KOUAKOU, B., FORSTER, L.A., Jr., GALLOWAY, D.L., SR., JOHNSON, Z. B. (1995) Effects of xylene and soybean meal addition to deep stacked broiler litter on nutritive characteristics for ruminants. *J. Appl. Anim. Res.* 7: 1-26.
- RANJHAN, S. K. (1980) *Animal Nutrition in the Tropics* (2nd Rev. Ed) Vikas Publ. House, PVT Ltd.; New-Delhi, India. pp 27-42.
- RUFFIN, B. G. and McCASKEY, T. A. (1990) Broiler litter can serve as a feed ingredient for beef cattle. *Feedstuff*, 62 (15): 13-17.
- SHAVER, R. D., NYTES, A. J., SATTER, L.D. and JORGENSEN, N. A. (1986). Influence of amount of feed intake and forage physical form on digestion and passage of prebloom alfalfa hay in dairy cows. *J. Dairy Sci.* 69: 1545-1559
- SMITH, L. W. and CALVERT, C. C. (1976) Dehydrated broiler excreta versus soybean meal in nitrogen supplements for sheep. *J. Anim. Sci.* 43 (6): 1286.
- SMITH, L. W. and CALVERT, C. C. (1972) Dehydrated broiler waste in ration for sheep. *J. Anim. Sci.* 35 (1): 275/428.
- STELL, R. G. D. and TORRIE, J. H. (1960) *Principles and procedures of statistics*, 1st Ed. McGraw-Hill Book Company, New York.
- VAN SOEST, P. J. (1963) The use of detergent in the analysis of fibrous feeds. 11. A rapid method for the determination of fiber and lignin. *J. Ass. Official Agr. Chem.* 46: 829 - 835.