DRIED POULTRY WASTE VERSUS GROUNDNUT CAKE AS PROTEIN SUPPLEMENT FOR GRAZING WEST AFRICAN DWARF GOATS AND SHEEP

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ABSTRACT

IN two separate experiments dried poultry waste (DPW) from caged-layer units was evaluated as a protein supplement for small ruminants. In experiment 1, nine goats divided into three groups of three animals each were randomly assigned to three diets containing 0,25, and 30% DPW in three periods of 17 days per period. Experiment 2 involved eight sheep, six of which were grazed and in addition fed in pairs to each of three diets containing 0, 20 and 30% DPW over a period of 12 weeks. The remaining two sheep were maintained solely on grazing during the same period of time.

Dry matter intake and digestibilities of dry matter, crude protein, crude fiber, other extract as well as liveweight gains and feed efficiency were not significantly different among the different treatments in experiment 1. Digestibility of nitrogen-free extract was however significantly (P 0.05) different. In experiment 2, the control diet was consumed significantly (P 0.01) more than the diet containing 20% DPW. In general, intake decreased as DPW inclusion increased, but performance of animals on DPW supplemented remained as good or even better than those on the control diet. While supplementation produced on increase in liveweight gain of between 48-58% over initial bodyweight in 12 weeks, grazing alone promoted an overall increase of 0.04% only during the same period.

INTRODUCTION

Intensive poultry production systems world-wide are generating waste excreta in localized polluting concentrations. These wastes represent a potential source of nitrogen for livestock, particularly ruminants. In the developed countries of the West, the necessity of disposing of these poultry wastes without polluting the environment has encouraged research into the utilization of poultry waste as protein supplement for livestock (see for example Noland, *et al* 1955; Bhattachary and Fontenot, 1966; Thomas, Tinnimit and Zindel, 1972; Smith and Calvert, 1976; in ruminants, and McNab, *et al* 1972; Lee and Blair, 1973 — in poultry). The high cost and irregularity of conventional protein supplements for livestock feeding in the developing countries of the world should further stimulate research into the utilization of dried poultry waste as protein supplement.

In two separate studies reported here the replacement value of dried poultry waste (DPW) was evaluated when it was incorporated into a groundnut cake — based diet at 0, 20, 25 and 30% levels of inclusion.

MATERIALS AND METHODS

Collection and Preparation of Poultry Waste:

Poultry waste (without bedding and feathers) was collected between 24—48 hours after being voided from a caged-layer unit during the months of November and December. The poultry waste was then spread out in large flat metal pans in the sun soon after collection and was stirred at intervals over a number of days to allow for uniform drying and also to minimize bacterial activity which might lead to loss of soluble nutrients particularly nitrogen and potassium (Blair, 1975). After drying the waste was milled to pass a 1 mm sieve, then stored away in bags until needed.

Experimental Design:

Experiment 1. Nine male mature West African dwarf goats divided into groups of three were used in a 3 x 3 latin square design replicated three times, involving three isonitrogenous and isocaloric rations (A, B, C) containing 0, 25, and 30% dried poultry waste (DPW) respectively

(Table 1). Each period consisted of 17 consecutive days. Total faecal collection was made during the last eight days for digestibility studies. The goats were housed in individual metabolism crates under the same environmental conditions and had access to water and salt licks *ad libitum.*

TABLE 1
Composition of diets
(Experiment 1)

Ingredient	*Diets*			
	A	*B* %	*C*	
Maize	30	30	25	
Rice bran	45	25	30	
Dried Poultry Waste (DPW)	0	25	30	
Groundnut Cake	25	20	15	
Vit. premix*	+	+	+	
Chemical Analysis (%)				*DPW*[1]
Crude protein (CP)	23.61	25.60	24.00	21.00
Gross energy (GE) MJ/Kg.	20.46	19.83	19.37	—
G.E.: C.P. ratio	0.87	0.77	0.81	—
Crude Fiber	8.16	7.24	8.87	16.75
Ether extract	11.12	9.8	8.95	1.25
Ash	7.10	9.56	10.7	18.5
NFE	50.01	47.76	47.76	31.50

**Vitmin premix contains per kg. diet:*
Vit A (5.2×10^6 i.u.), vit D_3 (1.04×10^6 i.u.),
Vit E (4×10^3 i.u.), Vit K (800 mg.)
Vit B (1000mg.), Vit B_2 (2000 mg.)
Vit B_6 (1600 mg.), Vit B_{12} (8.mg.)
Biotin (20 mg.)
1 = Dried Poultry Waste.

Experiment 2:

Eight West African dwarf sheep weighing on the average 10kg. were used in a randouised block design experiment of four treatments lasting for a period of 12 weeks (January-March) during which time rainfall was scanty (0-63mm) and temperatures high (33-34°C). Three diets D_1, D_2 and D_3 containing 0,20 and 30% DPW respectively were formulated to be isonitrogenous and isocaloric. The fourth diet type (D_4) was pasture (grazing) only. Two animals were assigned to each diet type. Since supplementary feeding was designed to add to the value of the pasture and not to replace it, all animals used in this experiment grazed together on a Giant Star-grass *(Cynodon nlemfuensis)* paddock. Six of the eight animals received the supplimentary diets D_1-D_3 (Table 2) which were offered twice daily, while the remaining two were maintained solely on grazing (diet D_4) which took place between 0900-1200 hours and 1400-1700 hours daily for all animals for a period of 12 weeks. Water and salt licks were supplied *ad libitum*.

Samples of uninterrupted growth of Giant-Star grass *(Cynodon nlemfuensis)* over the 12 weeks period were obtained biweekly from an adjacent plot and subjected to proximate analysis.

Analytical Methods:

The dry matter of feed ingredients, diets, pasture samples and faeces were determined by drying at 100°C for 24 hours. Crude protein (CP), crude fiber (CF) and other extract (EE) determinations were done according to the A.O.A.C. (1970) method of analysis. Ash content was determined by ashing samples in electric furnace (Blue M Electric Co., U.S.A) at 550°C for 6 hours. Calcium and phosphorus contents were determined by the use of Atomic Absorption Spectrophotometer according to A.O.A.C (1975) method. Gross energy, where determined, was by the use of Parr Adiabotic Bomb Calorimeter using benzoic acid as standard.

TABLE 2
Composition of diets

(Experiment 2)

Ingredient %	*Diet Types*				
	D_1	D_2 %	D_3 *(C nlemfuensis)*	D_4	(pasture)
Maize	72.50	56.70	48.50	—	
Groundnut cake	27.30	22.60	20.30	—	
Dried poultry waste (DPW)	0	20.0	30.0	—	
Palm oil	0	0.50	1.0	—	
Vit/Min mix*	0.20	0.20	0.20	—	
Chemical Analysis %					
					DPW
Crude protein (CP)	19.57	19.68	19.46	10.9-7.1	17.0
Gross energy (GE) MJ-Kg.	17.51	16.84	16.54	—	—
GE: C.P. ratio	0.90	0.90	0.85	—	—
Crude fiber	3.55	5.40	7.6	36.8-40.0	17.55
Ether extract	4.10	3.40	3.90	1.5-1.0	1.15
Ash	3.70	6.70	7.63	3.2-2.7	16.77
NFE	59.88	54.88	50.26		31.18

**Vit and mineral supplement contains per kg. diet:*
Mn (40 mg), Fe°3 (42 mg.) Zn (38), Co (1.3 mg) Cu (2 mg.)
Vit A (6 x10^3 i.u.), Vit D_3 (1.2 x 10 i.u.)
Vit E (25 x 10 i.u.)

Statistical Analysis:

Experiment 2 was blocked into weeks and therefore had twelve replications. The data obtained in the two experiments were subjected to analyses of variance and the differences between satistically significant means were compared using either the Duncan's Multiple Range Test or the Least Significance Difference (LSD, Steel and Torrie, 1960).

In Experiment 1, one goat died in the second period thereby creating a situation for missing data which were estimated by using the formula developed by Kempthorne (1974).

TABLE 3

Responses of west African dwarf goats fed diets containing different levels of DPW in three different periods (Exp. 1)

	Diets		
	A	*B*	*C*
Level of DPW inclusion %	0	25	30
Ave Dry Matter (DM) intake g/d	445.2	392.3	365.4
Total N intake g/d	16.83	16.08	14.03
DPW-N, % of total	0	25.00	30.00
DM intake, % of mean body wt.	2.35	2.14	1.88
Gain, g/d	85.00	57.92	67.66
Efficiency of Feed Conversion (feed)/(gain)	5.24	6.77	5.40
No. of goats	3	3	3
Apparent digestility %:—			
Dry Matter	81.34	73.0	73.61
Crude protein	84.49	79.69	80.30
Crude fiber	63.32	45.69	52.66
Ether Extract	90.30	88.29	90.60
NFE	86.12[a]	79.50[b]	80.13[b]

a, b. Means followed by dissimilar letters are significantly ($P < 0.05$) different.

RESULTS AND DISCUSSION

Experiment 1.

The results of Experiment 1 are shown in Table 3. Dry matter intake was higher for the control diet than for the diets containing DPW. Differences were however not statistically significant. The least daily feed intake was recorded in the group of goats consuming the diet containing 30% DPW. Dry matter intake, expressed as per cent of body weight was least at 1.88% for the diet containing 30% DPW, and highest at 2.35% for the control diet. The comparative figure for the diet containing 25% DPW was 2.14%. It would appear that palatability of the diets decreased as the level of DPW increased from 0-30%. In general greater values for apparent digestibility of dry matter, crude protein, nitrogen free extract, crude fiber and either extract as well as weight gains and

TABLE 4

Responses of West African dwarf sheep grazed and fed diets containing diffrent levels of dried poultry waste (DPW)

(Expt. 2)

Diet Types

	D_1	D_2	D_3	D_4
Level of DPW inclusion (%)	0	20	30	0
Ave Dry Matter (DM) intake g/d	367.4	337.6	288.6	—
Nitrogen intake g/d	11.5	10.6	9.0	—
DPW-N, % of Total	0	19.0	28.0	0
Estimated total N intake g/d*	16.83	15.50	13.18	—
DM intake % of mean body wt.	3.27	3.55	2.51	—
Gain, g/d	65.5	65.5	65.5	0
Ratio of Finishing to initial wt.	1.43	1.58	1.48	1.00
Finishing wt. minus initial wt. (kg)	5.5	5.5	5.0	0
Per cent of total gain over initial wt.	49.0	58	48	0.04
Apparent feed efficiency (feed intake) (gain) $\frac{\text{(feed)}}{\text{(gain)}}$	5.61	5.15	4.41	—
Mean weekly rate of gain (kg.)	0.5 ± .09	0.5 ± 0.06	0.5 ± 0.06	0.04 ± 0.09
No. of sheep	2	2	2	2

— = *not determined*
* = *Estimated pasture N intake (based on intake/% BW) + ration nitrogen intake).*

utilization were found for the control diet than for the DPW suplemented diets. These are in agreement with the findings of Bhattacharya and Fontenot (1966). Lowman and Knight (1970) and Tinnimit *et al.* (1972). With the exception of NFE digestibility values which were significantly ($P < 0.05$) different, the others showed non-significant differences. At the 25 and 30% inclusion of DPW, apparent digestibilities of the parameters measured (see Table 3) showed marginal but non-significant increase at the 30% level of inclusion than at the 25% level of inclusion.

Average daily weight gains in this study ranging from 58-85g. were generally lower at least by 50% than those reported in the temperate regions (Smith and Calvert 1976, Smith and Lindahl 1977) for sheep. The differences could have been due to species differences, sex differences, environmental or genetic make-up, since the West African dwarf goats and sheep are yet to be properly categorized. An important factor contributing to this difference in weight gain is probably due to the differences in dry matter consumption between these classes of animals. While the average temperate lamb consumed about 1000 g/day (Smith and Calvert 1976; Smith and Lindahl 1977), the West African dwarf goats and sheep consumed on average 400g/day for diets of similar energy densities. The efficiency of feed conversion (feed/gain) is however similar ranging between 4-6.7 in the present study and in those of Smith and Calvert (1976) and Smith and Lindahl (1977) for both control and DPW supplemented diets. This would suggest that the present level of DPW inclusion (25-30%) could be used in diet for fattening or growing goats.

Experiment 2.

Table 4 summarises the result of experiment 2. At 0,20, and 30% DPW inclusion, dry matter intake excluding pasture dry matter consumed were 367.4, 337.6 and 288.6g respectively. The control diet (D_1) and the diet containing 20% DPW inclusion (Diet D_2) were significantly (P 0.01) more consumed than diet D_3 (containing 30% DPW). As in experiment 1, dry matter intake decreased with increasing level of DPW inclusion. There was however no significant difference between the amounts of diets D_1 and D_2 consumed. Oliphat (1969) had earlier demonstrated that the inclusion of DPW up to a level of 27% lowered the energy content of the diet compared to a control, such that both feed intake and live-weight gain were adversely affected. In the present study, the diets were made isocaloric by the addition of palm oil to the DPW supplemented diets (Table 2). Despite the decrease in feed consumption with increasing level of DPW inclusion, liveweight gains and feed efficiency were similar for sheep on diets D_1,D_2 and D_3 (Table 4). The sheep which were maintained solely on grazing alone (ration type D_4) performed significantly (P 0.01) poorer than those which in addition to grazing also received supplemental diets.

Figure 1 illustrates the effect of supplementation and/or non-supplementation on liveweight gain in sheep over a 12 week feeding period. While supplementation resulted in an overall linear increase in liveweight gain (r = 0.99, 0.99 and 0.99; P/0.001) for sheep on diets D_1,D_2 and D_3 respectively, the non-supplemented animals barely maintained their weight during the same period (r = -0.36; P/0.01). These results are in agreement with the findings of Johnson and Strong (1958) who reported that supplemental feeding resulted in a continuous weight gain in steers maintained and on range over those maintained solely on range pasture. Percent of total weight gain over initial liveweight were 49,58,48 and 0.04 for diets D_1 (control diet) D_2 (20% DPW), D_3 (30% DPW) and D_4 (pasture grazing only) respectively. This would suggest therefore that the DPW supplemented diets were as good or even better than the control diet in supporting weight gain. During the same period under study, pasture grazing alone succeeded at best only in maintaining the liveweight of the experimental animals involved. The shape of the adjusted growth curve (Fig. 1) for the animals maintained solely on pasture would appear to confirm the pattern of the nutritive value of the pasture at the particular time under study. Data on the chemical composition (table 2) of *Cynodon nlemfuensis* samples obgrowth shows a decrease in crude protein content — all of which point to the poor content — all of which point to the poor quality of the pasture forage prevalent at the particular period of this experiment which was at the peak of the dry season. Based on an assumed intake of 3% of body weight, each of the animals maintained solely on pasture grazing would be consuming only 255g of forage for a total of 3.7g of nitrogen per day. This would be far short of the minimum necessary to meet the energy and nitrogen requirements of the animal per day; hence the very poor performance recorded for that group. Supplemental feeding is therefore recommended during the dry season and as much as 30% of the total dietary nitrogen could be contributed by dry poultry waste.

CONCLUSION

The results would indicate substantial benefits in productivity of dwarf goats fed mixed diets containing up to 30% DPW, as well as dwarf sheep fed supplemental diets containing up to 30% DPW when compared with those on pasture alone. Furthermore, there was no significant loss of productivity when DPW was included up to 30%, as compared with control (no DPW included). Besides possibly reducing the cost of production, DPW inclusion in diets will also help to minimize its polluting concentration to the environment as well as reduce the competing demand for the conventional protein supplements on the market.

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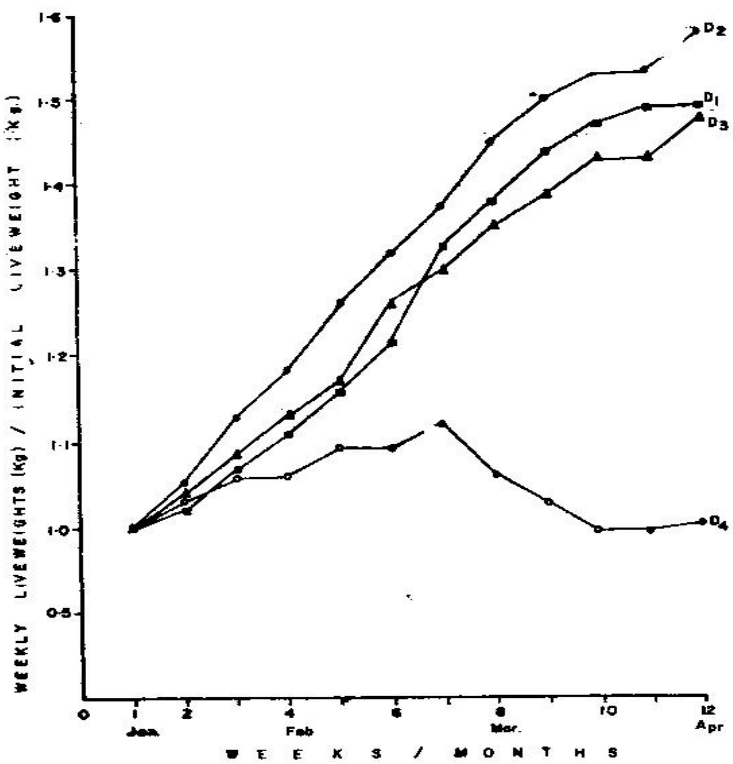

Fig. 1

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