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Rumen Metabolism of Sheep Fed Diet Containing Poultry Excreta

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Abstract: Five mature Arabi rams was used to study the effect of five different diets via control, control + 10% Poultry Excreta (PE), control + 10%PE + 3 gm yeast (*S. cerevisiae*)/kg, control + 1.5% urea and control + 1.5% urea + 3 gm yeast, by using Latin squares design on consumption and rumen metabolism. Control ration consist of 40% concentrate (60% barley, 36% wheat bran and 4% soybean meal) and 60% wheat straw on dry basis. Generally chemical composition of concentrate, wheat straw and poultry excreta were close to tabulated value of NRC. DM, OM and NDF consumption of control + yeast + PE and control + yeast + urea significantly exceeded those of other groups. pH, total nitrogen and ammonia nitrogen of rumen fluids followed the same trend as consumption.

Key words: Arabi rams, wheat straw, poultry excreta

INTRODUCTION

Available forages consumed by ruminants in tropics and arid zones have low (below 55%) digestibility and often less than 8% crude protein (Youser, 2006, in Iraq). Without supplements, these low levels of production lead to a highly insufficient use of the available feed, with a possibility that up to 30% of the feed consumed is dissipated as heat which reflected negatively on feed intake.

The nutrient content of poultry manure has been widely studied. The general agreement in all past research reports is that the nutrient in manure will vary from farm to farm depending on the quality of the ration offered to the birds, their age, amount of feed wasted, the amount of water spillage and more importantly, the type and amount of bedding used (Lanyasunya *et al*., 2006).

Mixing poultry waste with molasses, cereal forages and grasses not only considerably increases their inherent low N concentration but also provide many basic nutrients such as energy, calcium, phosphorus and micronutrients. In this way the poultry waste can be recycled as feed for livestock with no undesirable effects on animal health. The aim of this study was to determine the effect of using different poultry excreta and other additives on the rumen metabolism of sheep.

MATERIALS AND METHODS

Five mature Arabi rams (51.1±4.6 kg) were assigned to five dietary treatments in a 5 x 5 Latin square design. The five dietary treatments were a basal diet comprising 40% concentrates, 60% wheat straw on DM basis as a control diet. Commercial broiler house excreta was sun dried, ground and stored for using it as 10% of a ration. Supplemented diets were: basal diet fed with either 3 g/kg yeast or 1.5 g urea/kg feed or both per day as well as molasses. Sheep were fed individually at 55 g DM/kg $BW^{0.75}$ per day, twice daily at 08:00 and 16:00 h. Supplements were top-dressed on the basal diets. Mineral blocks containing Fe 1232; Cu150; Co25; Zn 500; I 50; Se 15 and Na382 mg/kg and clean water were available throughout the experiment. Diets were fed for a 10 day adaptation followed by a 7 day collection period. On Days 1-5 of the collection period, total daily fecal outputs were collected and weighed from each animal. Feces were collected using collection bags. At the end of each collection period, feces were pooled by animal and subsamples taken for analysis. Fecal samples were initially dried in a forced air oven at 60°C for 72 h.

Samples of feed and dried feces were Wiley mill ground (1 mm screen) for subsequent analyses. On Days 6 and 7 of the collection period, rumen samples were drawn from all sheep via the rumen tube on six occasions (0, 1, 2, 4 and 6 h after the morning feeding). The pH was recorded immediately after sampling using a pH meter (HM-21P). Samples were stored under -20°C for later ammonia nitrogen determinations.

The DM, OM and Kjeldahl-N of feed and fecal samples were determined by AOAC (1990) procedures. NDF, ADF and ADL were analyzed according to the methods described by Van Soest *et al.* (1991). Both the NDF and ADF were measured on an ash-free basis. Concentrates were analyzed with amylase without sodium sulfite. Ruminal ammonia-N was determined by the micro diffusion method modified by Conway and Fitzgerald (1942). Energy content in feed and feces were determined according to MAFF (1975, ME MJ/kg = 0.12CP% + 0.31EE% + 0.05CF% + 0.14CHO%).

The analysis of variance for Latin square experiments using the General Linear Model Procedure of SPSS (2006) examined the effects of ram, period and dietary treatment in the model. Data on ruminal ammonia-N and pH collected at each sampling time were analyzed

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with the General Linear Models procedure of SPSS (2006) for repeated measures. In case of significant difference in main effects, contrasts were evaluated and least square means were separated using the Least Significant Differences.

RESULTS AND DISCUSSION

The nutrient composition of poultry excreta, concentrate and wheat straw is shown in Table 1. Poultry excreta and wheat straw had higher NDF, ADF and ADL than the concentrate. Generally chemical results are close to tabular values in NRC (2001).

Different treatments feed consumption is shown in Table 2. Treatments showed significant ($p<0.05$) differences in dry matter, organic matter and NDF amount (gm) consumed. Adding yeast increased both dry and organic matter consumption in comparison to urea group alone and control. Live yeast used as a dietary feed additive for ruminant present an intrinsic capacity to reduce the reduction potential level can be a good means to stimulate adequate microflora for better digestive efficiency of the diet (Wallace, 1994). Furthermore live yeast influences the bacterial populations in the rumen, feeding live yeast at non-nutritional levels (0.5-20 g/d) effects the bacterial population in the rumen, increase in microbial protein and more fiber degradation and above all increase in bacterial numbers, even up to 130% (Newbold *et al.*, 1995).

Apparent nutrient digestibility of sheep fed different treatments is shown in Table 3. The effects of live yeast or urea caused a significant ($p<0.05$) increase in all studied nutrients. The highest and the lowest ruminal pH values ($p<0.01$) were recorded for sheep in 2.5 g LYSC and control groups, respectively (Fig. 1). Total nitrogen post-feeding (the total ammonia %) of rumen fluid was increased ($p<0.05$) from 92.66 (38.16%) to 132.00 (29.11%) mg/L in control vs. yeast groups (Table 4).

Table 1: Chemical composition (g/kg) of poultry excreta, concentrate, wheat straw and mixed

	Poultry excreta	Concentrate*	Wheat straw
Dry matter	90.12	90.33	93.65
Organic matter	83.60	82.14	90.20
Crude protein	23.52	10.93	4.50
NDF	32.55	27.70	51.20
ADF	16.15	13.30	79.90
ADL	17.23	16.40	31.12
GE (MJ/kg)	10.33	11.24	9.35

Concentrate included 60% barley, 36% wheat bran and 4% soybean meal

Stimulation of fiber degradation in the rumen caused by yeast is modulated via an increase in the number and activity of cellulolytic bacteria (Callaway and Martin, 1997; Koul *et al.*, 1998), with the effect on fiber digestion differing according to fiber source tested (Roa *et al.*, 1997).

Because the degradation of high quality feed proteins to NH_3 in the rumen and re-synthesis of microbial protein from NH_3, is a wasteful process for high quality feed proteins, using urea as a supply of degradable feed N for ruminal bacteria may be more economical than using natural protein sources (Shain *et al.*, 1998). However, Bolukbasi (1989) suggested that excess urea in ruminant diets could decrease the reduction of nitrite to ammonia, thereby allowing nitrite to accumulate in the rumen. Saadullah *et al.* (1982) noted that dry matter digestibility was increased by six units when urea was added as a supplement at the point of feeding but by 11% units when it was added to the straw 10 days previously.

Table 2: Feed consumption of different diets

Chemical composition	Treatments Control	Control + 10% PE*	Control + yeast + 10% PE	Control + urea	Control + yeast + urea	SEM	p-value
DM	1051^b	1056^b	1106^a	1089^b	1113^a	66	0.05
OM	971^b	1011^b	1032^a	980^b	1023^a	59	0.05
CP	168	170	178	169	177	16	NS
ADF	135	143	144	135	142	26	NS
NDF	254^b	269^a	270^a	257^b	268^a	25	0.05
ME (MJ/D)	12.2	12.4	13.1	12.2	12.9	1.4	NS

*PE = Poultry Excreta

Table 3: Apparent nutrient digestibility of sheep fed different levels of poultry excreta with yeast or urea

	Treatments Control	Control + 10% PE*	Control + yeast + 10% PE	Control + urea	Control + yeast + urea	SEM	p-value
DM	63.2	62.8	67.6	66.9	69.4	1.5	0.05
OM	64.5	64.0	68.3	67.5	70.0	1.3	0.05
CP	58.9	57.8	65.3	64.8	66.5	1.7	0.05
ADF	45.7	46.2	49.3	50.4	53.6	1.9	0.05
NDF	52.1	52.4	56.1	55.7	57.1	2.3	0.05

*PE: Poultry Excreta

Table 4: Total protein and ammonium nitrogen of rumen fluid collected from different rams

Treatments	Time (hr.)	Total N (mg)	Ammonia N (%)	Protein N (%)
Control	0	89.40	40.62	46.53
	3	96.50	37.77	58.76
	6	92.10	36.08	55.99
	Average	92.66	38.16	53.76
Control + 10%PE	0	87.30	41.12	46.34
	3	98.20	37.12	59.00
	6	93.40	36.00	57.23
	Average	92.97	38.08	54.19
Control + 10%PE + 3 gm yeast/kg	0	127.80	23.16	89.13
	3	120.30	33.64	83.31
	6	148.00	30.53	105.36
	Average	132.00	29.11	92.60
Control + 1.5 gm urea/kg	0	88.40	20.52	56.22
	3	109.20	27.83	72.38
	6	104.50	24.75	71.33
	Average	100.70	24.37	66.64
Control + 3 yeast + 1.5 urea	0	100.98	28.10	63.96
	3	108.71	33.08	71.50
	6	114.98	30.50	77.65
	Average	108.22	30.56	71.04

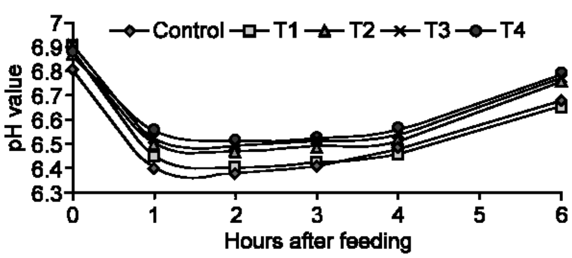

Fig. 1: Ruminal pH in sheep fed different experimental diets (control, T_1: Control + 10% PE, T_2: control + yeast + 10% PE, T_3: control + urea, T_4: control + yeast + urea)

Both feed intake and milk production in ewes was not affected by the inclusion of 14% poultry waste as a dietary supplement, suggesting that cottonseed meal and other high protein feed ingredients could be, at least partially replaced, by poultry waste without any loss in productivity.

Increase in rumen pH in animals fed live yeast was itself a secondary effect, with live yeast stimulating the growth of lactic acid utilizing bacteria (Newbold *et al.*, 1995) while preventing acid production from hexose fermenting bacteria (Chaucheyras *et al.*, 1995).

Results as shown in Table 4 indicate that the difference between N were significant ($p<0.05$). It was noted that the concentration of ammonia in the rumen when cattle was fed poultry litter from 3.1 to 6.0 kg daily, was 3 to 5 times higher than the optimal level of 10 mg/dL for maximum fermentation and optimum microbial protein synthesis (Silanikove and Tiomkin, 1992). When requirements for microbial N in the rumen were met, there should be a further increase in the rate of fermentation. Excessive consumption of poultry waste exposes the cow to the burdens of metabolism, as shown in the ammonia (>20 mg/dL) and focus and reduces the life span of the cell (Visck, 1984). It can be concluded that the use of yeast or urea or both could improve the ruminal fermentation and resulted in a relatively better performances.

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