Effects of Infusing and Feeding Antibiotic on Growth and Nutrient Balance in Sheep

By

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SUMMARY

TWO growth trials and nutrient digestibility studies were done using 12 Hampshire Rambouillet cross-bred lambs given antibiotic orally or abomasally. Daily gain and efficiency of feed utilization were lower in the abomasally-infused animals. Crude fibre, protein, dry and organic matter digestibility was significantly lower [$P < 0.05$] in those on oral antibiotics, as was the statistically significant difference in phosphorus intake [$P < 0.05$]. A 2-way analysis of variance showed that antibiotic administered orally or intra-abomasally did not significantly effect any changes in serum calcium and phosphorus balance. The average daily gain obtained in the second growth trial when the abomasally-infused group was switched on to oral antibiotic was the same as those on oral antibiotic from the start. These data indicate that oral route of antibiotic administration is preferable.

INTRODUCTION

THE world need for animal protein is increasing. This is more so in Nigeria where there is a spiralling increase in meat prices as well as decreasing number of animals available for slaughter (Kano, 1974). Measures taken to increase the growth rate and improve nutrient balance of livestock would make great contribution towards alleviating this protein shortage. Murley, Allen and Jacobson, (1951) reported a greater increase in blood sugar

level in chlortetracycline-fed calves than in the controls. Russoff, Fussell, Hyde, Crown and Gall (1954) administered chlortetracycline intramuscularly, bypassing the rumen; they postulated that the rumen was not where growth was stimulated. This was supported by Hester, Landagora and Russell (1954).

The investigation reported here was on the effect of feeding and abomasally infusing oxytetracycline/neomycin sulphate mixture on the growth performance of sheep and on their nutrient balance.

MATERIALS AND METHODS

Animals and their management

Two growth trials were conducted with 12 Hampshire Rambouillet cross-bred lambs aged 4 months. They were allotted to 4 groups of 3 lambs each.

Feeding and plan of experiment

The lambs were fed in a 2x2 factorial arrangement of treatments in a completely randomized design. Two of the groups were cannulated using Pezzer cannulas³ (Akerejola, Noordsy and Harbers 1974). Three groups (2 cannulated, 1 control

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3 Pezzer Mushroom Head Catheter, French 40-Arista.

TABLE 1

Percentage composition of basal diet

Item	Percentages	
	Ration 1	Ration 2
Soya bean oil meal	5.0	5.0
Ground grain sorghum	39.0	39.0
Dehydrated alfalfa	50.0	50.0
Molasses	5.0	4.9
Salt	0.5	0.5
Ammonium chloride	0.5	0.5
Antibiotic ¹ 20/20		

¹Oxytetracycline hydrochloride/neomycin sulphate

uncannulated) received the basal pelleted diet (Table 1 ration 1). The uncannulated group received the same basal diet supplemented with antibiotic (Table 1 ration 2). Feeding was *ad libitum* for 45 days in the first growth trial. One cannulated group received abomasal infusion of antibiotic daily at 88 mg/kg. of the average daily intake. Equivalent quantities of physiological saline solution were administered to the other cannulated group. A second 30-day growth trial was conducted after the balance trial to evaluate the effect of oral administration of oxytetracycline in the abomasally-cannulated sheep. The group infused with antibiotic and the uncannulated group which received oral antibiotic in Trial 1 were kept on Ration 2. The other groups were kept on Ration 1 without infusion of physiological saline solution in the cannulated group. Animals were weighed at the start of the experiment and weekly thereafter.

Collection of blood, Urine and Faeces

Blood samples were taken weekly for analysis. Nutrient utilization studies were carried out after the first growth trial by keeping the animals individually

in metabolism stalls for two weeks. The first seven days for adjustment and the last seven days for urine and fecal collection. Abomasal infusion of antibiotic and physiological saline solution continued.

Analytical procedure

The analysis of the proximate components of the feeds, urine and faeces were done according to AOAC methods (1970). Calcium analysis was by atomic absorption spectrophotometer⁴ and phosphorus by colorimetric methods (Fiske and Subbarow, 1925). Abomasal pH was measured⁵ after three consecutive days of infusion. Back fat was measured by sonar ray using live animal.

RESULTS

Data on growth performance of lambs are summarized in Table 2 and 3. Average feed intake was slightly higher while efficiency of feed utilization and daily gain were lower in the group receiving antibiotic infusion. Average abomasal pH was 3.5.

⁴ Jarrell — Ash Atomic absorption spectrophotometer 82-500

⁵ Beckman pH meter.

Table 4 shows nutrient balance data. Crude fibre digestibility in the group receiving oral antibiotics was significantly lower ($P < 0.05$) than in the other treatment groups. Slight differences were found in the protein, organic and dry matter

digestibility between the antibiotic-fed group and the other groups. The nitrogen balance data indicate a higher nitrogen intake but lower percent absorption and retention in the groups receiving antibiotics.

TABLE 2
Performance data of lambs during growth trial I

Items	Treatments			
	1 No antibiotic No. Cannula	2 Antibiotic, ^a No Cannula	3 No antibiotic, Cannula	4 Antibiotic, Cannula
Number of Lambs	3	3	3	3
Time on Feed, days	45	45	45	45
Initial weight, kg.	32.50	32.95	31.06	31.82
Final weight, kg.	40.60	42.12	39.47	37.01
Daily gain, kg.	.18	.20	.19	.12 $\pm$ 0.52 ^b
Daily feed intake	1.25	1.20	1.13	1.27
Efficiency of feed utilization (gain/feed), %	14.40	16.65	16.81	9.4

^a Noncannulated animals received antibiotic orally in feed; abomasally cannulated animals were given a solution of antibiotics by cannula once daily.

^b Standard error of mean.

TABLE 3
Performance data of lambs during growth: trial II

	Treatments			
	1 No antibiotic No Cannula	2 Antibiotic No Cannula	3 No Antibiotic Cannula	4 Antibiotic Cannula
Number of lambs	3	3	2 ^a	2 ^b
Time on feed, days	29	29	29	29
Initial weight, kg	41.97	43.48	38.86	41.14
Final weight, kg	45.98	49.92	44.32	47.50
Daily gain, kg	0.14	0.22	0.19	0.22 $\pm$ 0.43 ^d
Daily feed intake, kg.	0.93	1.12	1.79	1.44
Efficiency of feed utilization (gain/feed), %	15.05	19.64	10.61	15.27
Back fat thickness, cm ^c	0.22	0.30	0.15	0.20

^a One animal died of acute serofibrinous bronchopneumonia.

^b animal was off feed for several days and was removed from group.

^c Measured by soner ray using live animal.

^d Standard error of mean.

TABLE 4

Effect of abomasal infusion and orally fed antibiotics on nutrient digestibility and nitrogen balance in lambs.
Mean value with the standard error of difference for three animals/group

Nutrients	Treatment means, %				SE
	1 No antibiotic No Cannula	2 Antibiotic No Cannula	3 No antibiotic Cannula	4 Antibiotic Cannula	
Digestibility					
Energy	74.19	68.29	73.52	74.26	0.03
Dry matter	77.56	73.03	76.30	77.34	10.54
Organic matter	79.64	74.87	79.12	79.53	0.89
Protein	72.80	62.70	71.08	73.76	1.28
Crude fibre	49.03 ^a	29.52 ^b	51.77 ^a	50.08 ^a	3.15
Ether extract	70.31	56.24	65.96	67.70	1.86
Nitrogen — free extract	86.13	83.28	85.29	85.82	0.58
Nitrogen balance (g/day)					
Intake	24.72	26.57	25.26	27.11	0.55
Faecal	6.79	8.07	7.35	7.90	0.42
Absorbed	17.93	18.50	17.91	19.21	0.82
Urine	10.56	13.24	10.47	10.08	0.54
Intake N retained, %	29.48	19.75	29.84	18.02	2.00
Absorbed N retained, %	40.48	27.75	41.86	28.77	2.59

a-b Rows with differing superscripts significantly different ($P < 0.05$).

TABLE 5

Effect of abomasal infusion and orally fed antibiotics on calcium and phosphorus balance in lambs. Mean value with the standard error of difference for three animals/group

	Treatment means				
	1 No antibiotic No Cannula	2 Antibiotic No Cannula	3 No antibiotic No Cannula	4 Antibiotic Cannula	4 SE
	Calcium balance (g/day)				
Intake	9.71	10.63	10.38	10.96	0.24
Faecal	7.40	8.41	6.44	7.06	0.35
Urine	0.061	0.077	0.059	0.058	0.009
Retained	2.07	1.85	3.89	3.86	0.32
Intake Ca retained, %	91.03	95.23	98.56	98.94	1.62
	Phosphorus balance (g/day)				
Intake	2.96b	3.62a	3.00b	3.01b	0.10
Faecal	2.21	1.90	2.24	2.13	0.15
Urine	0.13	0.24	0.10	0.20	0.03
Retained	0.62	1.48	0.66	0.87	0.14
Intake phosphorus retained, %	20.94	40.88	22.00	27.10	3.90
Absorbed phosphorus retained, %	28.66	86.04	86.84	80.55	2.34

a-b Rows with differing superscripts significantly different ($P < 0.05$).

Table 5 shows the results obtained in the mineral balance trial. Phosphorus intake shows higher significant difference ($P < 0.05$) between the group receiving oral antibiotic than the other groups. Significantly higher difference ($P < 0.05$) were noticed in the percent calcium retained of intake between the cannulated groups than the uncannulated groups.

DISCUSSION

The higher daily gain in the group receiving oral antibiotic in trial 1 supports the findings of Russoff *et al* (1953) who demonstrated that oral administration of chlortetracycline improved average daily gain better than intramuscular injections. Richardson, Ronning, Berousek and Norton, (1953) also reported no advantageous growth promoting effect by subcutaneously or intramuscularly injecting chlortetracyclines in calves over oral feeding. This study seems to confirm the superiority of oral compared to the abomasal route in antibiotic administration for performance purposes. Observations of average daily gains by the antibiotic infused sheep switched to oral antibiotic in growth trial 2 confirms this, since equal gains were shown compared with those already on oral administration.

The lower crude fibre digestibility in the group receiving oral antibiotic as compared to other treatment groups may be due to the depression of cellulolytic microorganism by the antibiotics, (Evans Grainger and Thompson, 1955, 1957, Keith and Lehrer, 1955; Munch and Armstrong, 1958).

The higher nitrogen intake may be related to the higher average feed intake observed in the groups receiving antibiotics. From this study it is observed that antibiotic administration increases loss of nitrogen although improving

efficiency of feed utilization and average daily gain. The gain may reflect a more efficient fat metabolism and fat deposition as seen in the values for back fat thickness in Table 3.

The statistically significant differences noted in phosphorus percent retained of intake between the group receiving oral antibiotic and the other groups may be due to a higher feed consumption during the period of observation. Similar results were obtained by Ahuja, Malik and Ichhponani, (1971) in chicken. The differences in the percent calcium retained of intake in the cannulated groups in relation to the uncannulated groups indicates that surgical cannulation probably caused changes in the serum calcium levels in the lambs.

From the results of both growth trials, it could be concluded that oral administration of antibiotics would be a preferable route to intral — abomasal administration. The slightly higher faecal calcium level in the group receiving oral antibiotics may be the result of antibiotic interference with absorption of calcium as proposed by Yeh and Shils (1966). However, measurements of the blood ionic calcium levels in an experiment with this same design carried out over a prolonged period might give a better basis on which conclusions can be made on the effect of antibiotics and blood calcium and phosphorus in sheep.

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