Effects of Protein Source on Performance of Rambouillet Rams

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Summary

A study was conducted to examine the effects of protein source on performance of Rambouillet rams. Thirty-six February-born ram lambs approximately eight months old were randomly allocated to four feed treatments with three replications per treatment and three rams in each replication. The treatments consisted of a control ration that contained soybean (SBM) and cottonseed (CSM) meals as the protein sources (a ration identical to that used in the Texas Agricultural Experiment Station's ram performance test held in Sonora, TX) and three treatments containing the following protein sources: blood meal (BM), fish meal (FM) and a combination of BM and FM. Each of the rations used in the study were formulated to exceed the NRC nutrient requirements for replacement ram lambs (NRC, 1985). Rams were shorn and weighed initially then weighed at 28-day intervals during the 112-day study. Feed intakes were calculated by pen (one replication) for each 28-day period to obtain an estimate of feed efficiency. At the conclusion of the test, animals were weighed and a mid-side wool sample was taken prior to shearing (112 days). Feed efficiency (gain per unit weight of feed consumed) tended to be higher ($P < 0.09$) in rams consuming the FM diet. Further, animals consuming the FM diet were consistently higher in overall live weight gain, average daily gain (ADG) and feed efficiency throughout the trial. However, no significant differences ($P > 0.05$) among treatments were observed, by weigh period, for weight gain, ADG and feed efficiency. Animals in the BM treatment tended to produce the shortest ($P = 0.07$) wool. In summary, the FM-based diet tended to result in faster, more efficient weight gains than diets based on the other protein sources.

Key words: sheep, protein, wool.

Introduction

The need to identify cost-effective protein sources that are capable of increasing wool production and feed efficiency of sheep is vital to improving the profitability of the sheep industry. Studies have been conducted to assess various protein sources on the performance of sheep and cattle. Schafer (1992) suggested that FM and CSM produced higher ADG in growing rams compared to feather meal. However, he also stated that feather meal was used more efficiently by sheep. Fahmy et al. (1992) concluded that sheep fed FM as a protein source exhibited superior ADG compared to animals fed SBM. Hussein and Jordan (1991) stated that the addition of FM to a diet would invariably increase ADG, but would not improve feed efficiency in sheep. Different protein sources have been demonstrated to alter rumen pH and volatile fatty acid (VFA) production (Hussein et al., 1991). These authors also concluded that FM diets produce a higher molar concentration of acetate and propionate in the rumen compared to SBM-based diets.

This study was designed to investigate the effects of protein sources on performance and wool characteristics of Rambouillet rams. The protein sources that were used are a CSM/SBM combination, BM, FM and a BM/FM combination.

Materials and Methods

Thirty-six Rambouillet ram lambs, approximately eight months old and 78 kg live weight, were acquired from the Angelo State University Management, Instruction and Research Center (San Angelo, TX). After

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[4] Ivermectin - Ivomec. A product of Merck and Co., Rahway, NJ 07065 USA. Dosage: 3 ml/12 kg live weight, administered orally.

[5] *Clostridium perfringens* Type C and D toxoid. Anchor Laboratories, Inc., St. Joseph, MO 64506. Dosage: 2 ml per lamb, injected subcutaneously.

weaning (at an average of 120-days of age), rams were maintained on a common ration for 90 days until initiation of the test in October, 1994, at which time the rams were treated for internal parasites[4] and vaccinated against enterotoxemia[5].

Rams were shorn and weighed at the initiation of the study. Rams were randomly assigned to treatments and pens with three replications per treatment and three rams per replication (pen). The four rations were formulated to be isonitrogenous and isocaloric (Table 1); however, after proximate analysis of the rations (Table 2), it was observed that the control ration (SBM/CSM) was approximately 1% lower in crude protein (CP) than the other rations. The observed variation in CP was a result of ration preparation by a commercial feed mill. Since all diets exceeded the National Research Council's (NRC) nutrient requirements for CP for replacement ram lambs (NRC, 1985), any differences or lack thereof among treatments may be attributed to protein source rather that level of crude protein. In addition, the BM ration was lower in Ca and P levels than the other three rations. However, the levels of these minerals were also within the NRC (1985) recommended levels. Essentially the only difference among rations was the source of the protein. SBM/CSM (control), BM, FM and a combination of BM and FM were the protein sources used in the rations. Diet samples were taken weekly and combined by weigh period for proximate analysis by a commercial laboratory. Rams were fed at a rate of 4% of their body weight per day and feeding rates were adjusted every 28 days using the pen average body weight. Clean, fresh water was available at all times.

Upon completion of the 112-day trial, live weights were recorded. Mid-side wool samples were removed and the rams were shorn to obtain grease fleece weights. Ten staples of wool were removed from random locations throughout each fleece and were used for staple length determination (ASTM, 1995b). Each fleece was cored (32-by-1.25 cm cores) and the

Table 1. Ingredient composition of experimental diets[a].

Ingredient	SBM/CSM[b] (Control)	BM[c]	FM[d]	BM/FM[e]
Corn	26.8	33.3	30.8	32.3
Urea	0.35	0.35	0.35	0.35
Salt	1.2	1.2	1.2	1.2
Alfalfa, dehy	29.0	29.0	29.0	29.0
Molasses	5.0	5.0	5.0	5.0
Calcium carbonate	0.5	0.5	0.5	0.5
Cottonseed hulls	24.0	24.0	24.0	24.0
Vitamin E	0.01	0.01	0.01	0.01
Selenium, 0.06%	0.04	0.04	0.04	0.04
Ammonium chloride	0.5	0.5	0.5	0.5
Vitamin A-44	0.01	0.01	0.01	0.01
TM[f] premix	0.08	0.08	0.08	0.08
Cottonseed meal	6.25	—	—	—
Soybean meal	6.25	—	—	—
Blood meal	—	6.0	—	3.0
Fish meal, menhaden	—	—	8.5	4.0

[a] All ingredients in % as-fed basis.
[b] SBM/CSM = soybean meal and cottonseed meal combination.
[c] BM = blood meal.
[d] FM = fish meal.
[e] BM/FM = blood meal and fish meal combination.
[f] TM = trace mineral premix. The percent ingredients of the premix are as follows: sodium chloride, 64.7; potassium chloride, 19; sulfur, 10; zinc oxide, 0.387; vitamin D (30,000 IU/g), 0.093; chlortetracycline (50,000 IU/g), 3.0; and molasses, 1.5.

Table 2. Nutrient composition of experimental diets[a].

Ingredient	SBM/CSM[b] (Control)	BM[c]	FM[d]	BM/FM[e]
Dry matter, %	91.2	91.2	91.9	90.8
TDN[f], %	64.2	64.0	64.7	64.0
Crude protein, %	14.5	15.5	15.1	15.4
ADF[g], %	25.0	25.8	25.3	24.8
NDF[h], %	37.6	36.8	36.2	34.7
NEm, Mcal/kg	1.4	1.4	1.4	1.4
NEg, Mcal/kg	0.84	0.84	0.86	0.84
Calcium, %	0.81	0.59	1.09	0.78
Phosphorus, %	0.36	0.18	0.43	0.36
Magnesium, %	0.22	0.15	0.19	0.15
Potassium, %	1.02	0.80	1.47	0.77
Sodium, %	0.19	0.28	0.25	0.11
Sulphur, %	0.22	0.20	0.24	0.23
Iron, ppm	256.5	295.2	213.6	203.0
Copper, ppm	5.03	5.02	3.00	9.90
Manganese, ppm	50.3	46.2	46.1	40.6
Zinc, ppm	44.3	36.1	34.1	39.6

[a] All nutrients on as-fed basis.
[b] SBM/CSM = soybean meal and cottonseed meal combination.
[c] BM = blood meal.
[d] FM = fish meal.
[e] BM/FM = blood meal and fish meal combination.
[f] TDN = total digestible nutrients.
[g] ADF = acid detergent fiber.
[h] NDF = neutral detergent fiber.

core samples (2-by-25 g) were used to determine lab scoured yield (ASTM, 1995a) and average fiber diameter of the entire fleece. Average fiber diameters were also determined for the mid-side samples. Both sets of average fiber diameters were determined using an Optical Fibre Diameter Analyser (OFDA) and a test method outlined by the International Wool Textile Organization (IWTO, 1995). Fibers from each side sample were measured at the tip and the base of the staple. This was done to determine fiber diameter at the initiation and at the end of the test to better assess the effect of protein source on average fiber diameter. All wool analyses were performed at the Texas Agricultural Experiment Station's Wool and Mohair Research Laboratory (San Angelo, TX).

Data were analyzed using analysis of variance to determine differences among protein sources. Animals were nested within pens and pens served as replications. Simple T-test analyses were conducted to compare two different protein sources when an overall treatment effect was not significant ($P > 0.10$; Hicks, 1993; SAS, 1995). When there was an overall treatment effect ($P < 0.10$), Fisher's least significant difference was used to distinguish differences among treatment means.

Table 3. Effects of protein source on animal performance.

	Treatments				
Variables	Control[a]	BM[b]	FM[c]	BM/FM[d]	SE[e]
Initial weight, kg	79.2	78.8	77.9	78.0	2.71
Final weight, kg	111.4[f]	113.2	116.6[g]	114.3	1.73
Weight gain, kg	32.3[f]	34.4	38.7[g]	36.3	2.01
ADG[h]	0.29[f]	0.31	0.35[g]	0.33	0.02
Feed efficiency[i]	0.080[f]	0.090	0.102[g]	0.097	0.002

[a] Combination of soybean meal and cottonseed meal.
[b] BM = blood meal.
[c] FM = fish meal.
[d] BM/FM = blood meal and fish meal.
[e] SE = standard error.
[f,g] Control or fishmeal means without a common superscript are different ($P < 0.1$).
[h] ADG = average daily gain, kg gain/day.
[i] Feed efficiency = kg gain/kg feed.

Table 4. Effects of protein source on wool production and fiber characteristics.

	Treatments				
Variables	Control[a]	BM[b]	FM[c]	BM/FM[d]	SE[e]
GFW[f]	12.0	11.7	12.4	12.9	0.70
Y[g]	50.7	49.8	49.8	49.1	1.40
CFW[h]	6.1	5.8	6.2	6.3	0.31
ASL[i]	14.5[j]	12.6[k]	14.1[j]	14.0[j]	0.58
Initial side AFD[l]	23.44	22.97	24.01	23.01	0.44
Final side AFD	23.58	23.28	24.52	23.61	0.45
Core AFD	23.10	22.48	23.58	22.86	0.50

[a] Combination of soybean meal and cottonseed meal.
[b] BM = blood meal.
[c] FM = fish meal.
[d] BM/FM = blood meal and fish meal.
[e] SE = standard error.
[f] GFW = grease fleece weight, kg; adjusted to 365 days.
[g] Y = lab scoured yield, %.
[h] CFW = clean fleece weight, kg; adjusted to 365 days.
[i] ASL = average staple length, cm; adjusted to 365 days.
[j,k] Means in the same row without a common superscript are different ($P < 0.05$).
[l] AFD = average fiber diameter, μm.

Results and Discussion

Animal Performance

Ram body weight gains were 32.3, 34.4, 38.7 and 36.3 kg per head for the control, BM, FM and BM/FM rations, respectively. Live weight gain for rams fed FM tended to be greater ($P = 0.09$) than for rams fed the control ration. However, there were no differences ($P = 0.26$) among the other three treatments (Table 3). The same trend in mean values was also observed for ADG with the FM treatment being greater ($P = 0.09$) than the control. Fahmy et al. (1992) reported similar results showing that ADG of FM and corn gluten meal fed lambs was higher ($P < 0.01$) than lambs fed SBM. No differences in ADG were detected among the other three treatments ($P > 0.10$; Table 3). Rams fed the FM ration also tended to be more efficient ($P = 0.09$) at converting feed to animal mass than rams in both the control and BM treatments. No differences in feed efficiency ($P > 0.25$) were detected among other treatments. No 28-day period effects ($P > 0.15$) were found for weight gain, ADG and feed efficiency. These results are similar to those reported by Hussein and Jordan (1991) and Fahmy et al. (1992) in which SBM and FM were compared. Our data suggest that using FM as a protein source for growing rams will tend to improve their performance, especially in terms of feed efficiency, compared to the alternative protein sources SBM, CSM and BM.

Wool Production

Rams fed the BM ration produced shorter ($P < 0.05$) wool than rams fed the control, FM or BM/FM rations (Table 4). Grease fleece weights (GFW), yields (Y), clean fleece weights (CFW) and average fiber diameters (AFD) were not affected ($P > 0.1$) by treatments. Except for the

staple length results, these results are in agreement with those of Schloesser et al. (1993) and Schafer (1992), who also reported no effects of protein source on wool production or quality. Our results indicated that the BM ration produced shorter staple length wool compared to the other rations.

Conclusions

The use of FM as the protein source in a ration fed at 4% of body weight to growing Rambouillet rams tended to increase overall weight gain and feed efficiency compared to the control ration (soybean meal and cottonseed meal). In contrast, the BM ration produced comparable weight gains while maintaining a relatively low AFD, but the BM ration resulted in shorter staple length wool. The combination BM/FM diet tended to produce results intermediate between BM and FM (yield and clean fleece weight being the exceptions). This study did not identify any advantages of BM over the control ration. The FM-based diet tended to be used more efficiently than the control ration and tended to produce higher ADG than the control or BM rations. However, FM is generally more expensive than other sources of protein and may not be a cost-effective alternative protein source. Our data indicate that additional research is needed to identify more efficient and less expensive protein sources with which to feed sheep.

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