

Whey-Grown Yeast as a Protein Source for Lambs

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Story in Brief

The potential of whey-grown *Kluyveromyces fragilis* yeast as a protein supplement for lambs was studied. Soybean meal or whey-yeast were fed at 11.0 percent or 14.0 percent protein rations to forty 75 lb crossbred ewe lambs in a performance study and to eight ram lambs in a nitrogen balance study. Results of both experiments indicated that, as a supplemental protein source for lambs, the value of whey-yeast was at least equal to that of soybean meal.

Introduction

The search continues for a low cost source of preformed protein which will bypass rumen destruction and yet be highly digestible post-ruminally. The objectives of this study were to determine growth performance, digestibility and nitrogen balance in lambs fed whey-grown yeast or soybean meal as a supplemental protein source.

Materials and Methods

The test product, whey-yeast, was prepared by growing *Kluyveromyces fragilis* (formerly - *Saccharomyces Fragiles*) yeast on cottage cheese whey. Prior to the animal experiments, soluble protein nitrogen of the product was determined at pH 6.5 and 5.5. Ruminal dry matter digestibility and nitrogen digestibility of the whey-yeast were estimated by incubating samples with rumen fluid for 24 hrs.

For the feeding trial, 40 crossbred ewe lambs averaging 75 lb in weight were fed the diets (Table 1) in a six-week growth trial. Lambs were housed in individual feeding pens and allowed a five-day adjustment period during which small amounts of feed were fed. After the adjustment period, feed and water were supplied *ad libitum*. Lambs were weighed full at the end of the adjustment period and then every two weeks thereafter.

In the nitrogen balance trial, eight crossbred ram lambs were fed the same four diets as in the feeding trial. Pairs of lambs were rotated among diets every 14 days until each pair received each of the four dietary treatments. Lambs were housed in individual metabolism stalls and feed and water were supplied free choice. During the last five days of each 14-day period, urine and feces were collected daily and analyzed for nitrogen and dry matter. Rumen fluid samples were obtained, and pH and ammonia concentrations determined. Blood samples were collected and urea-nitrogen content of plasma was determined.

Results and Discussion

Solubility of the whey-yeast protein nitrogen was 2.8 percent at pH 6.5 and 2.3 percent at pH 5.5. Under similar conditions, solubility values of 41, 13 and 7 percent have been reported for dried whey, soybean meal and cottonseed meal, respectively (Wohlt *et al.*, 1973). Values for ruminal dry matter and protein digestibilities of the whey-yeast averaged 28.9 and 20.0 percent, respectively. Corresponding values for soybean meal were 67 and 65 percent. Literature indicates that protein degradation in the rumen tends to increase with protein solubility. With the low nitrogen solubility

Table 1. Composition of the diets used in growth and metabolism trials.

Ingredients*	% Composition (as-fed)			
	Diet no.			
	1	2	3	4
Corn	62.48	64.13	54.18	58.87
Soybean meal	4.51	-	12.81	-
Whey-grown yeast	-	2.86	-	8.12
Cottonseed hulls	25.00	25.00	25.00	25.00
Urea	0.86	0.86	0.86	0.86
Molasses, cane	5.00	5.00	5.00	5.00
Calcium carbonate	0.85	0.85	0.85	0.85
Trace-mineralized salt	0.50	0.50	0.50	0.50
Sodium sulfate	0.50	0.50	0.50	0.50
Potassium chloride	0.30	0.30	0.30	0.30
Crude protein, Nx6.25	11.07	10.97	14.00	13.98
Calcium	0.42	0.42	0.45	0.44
Phosphorus	0.25	0.24	0.28	0.24

* 45,360 IU of vitamin A palmitate and 6, 350 IU of vitamin D were added per 100 pounds of each diet.

Table 2. Growth trial results.

	Diet			
	Soybean	Yeast	Soybean	Yeast
Protein source	Soybean	Yeast	Soybean	Yeast
Protein level, %	11.1	11.0	14.0	14.0
No. of lambs	10	10	10	10
Mean initial wt, lb	76.9 ^a	73.4 ^b	77.3 ^a	73.5 ^b
Daily feed, lb/day	2.84	2.77	2.91	2.64
Daily gain, lb/day	0.6	0.7	0.6	0.6
Gain: feed ratio	0.2	0.3	0.2	0.2
Daily protein, lb/day	0.31 ^a	0.30 ^a	0.41 ^c	0.37 ^b
Gain: protein in ratio	1.6 ^a	2.2 ^b	1.5 ^a	1.6 ^a

^{abc} Means in a row with different superscripts differ significantly ($P < .05$).

and low ruminal protein digestibility, it was anticipated whey-yeast protein should resist destruction in the rumen.

Growth trial results are summarized in Table 2. Palatability problems were not observed with any ration. Throughout the experiment, neither source nor level of dietary protein affected rate of gain or efficiency of feed utilization, although the yeast fed lambs averaged 0.5 percent faster gains and 7.2 percent greater efficiency of feed utilization than the soybean meal fed lambs.

Results of the nitrogen balance trial are summarized in Table 3. Diets did not differ statistically in dry matter digestibility but yeast diets averaged 2.8 percent higher in digestibility. The higher ($P < .05$) nitrogen digestibility coefficients at 14.0 percent protein can be attributed to more supplemental protein and less corn protein in those rations. In the former experiment, the highest rate of gain and protein efficiency ratio was produced by the low nitrogen whey-yeast diet. In this experiment, the highest nitrogen balance was obtained with the same diet. Rumen ammonia nitrogen values tended to be slightly lower with yeast diets. The differences were not large enough to statistically implicate increased protein bypass with yeast diets. Level of protein had no effect on rumen pH but pH was lower with yeast supplementation.

Table 3. Metabolism trial results.

	Diet			
	Soybean	Yeast	Soybean	Yeast
Protein source	Soybean	Yeast	Soybean	Yeast
Protein level, %	11.1	11.0	14.0	14.0
No. of lambs	8	8	8	8
Digestibility %				
Dry matter	65.6	70.0	68.0	69.2
Nitrogen	78.0 ^a	80.9 ^a	84.3 ^b	83.6 ^b
Nitrogen retained, g/day	6.0	6.5	8.9	5.1
Rumen ammonia-N, mg/day	20.6	19.4	22.8	21.0
Rumen fluid pH	6.39	6.18	6.34	6.11

^{ab} Means in a row with different superscripts differ significantly ($P < .05$).

Little literature information is available regarding whey-yeast as a protein supplement for ruminants. The performance and nitrogen balance data obtained in this study suggest that, as a supplemental protein source, its value is at least equal to soybean meal. Microbial protein is added to or present in certain feedstuffs like fermented whey and liquid supplements for cows on range. Whether microbial protein in liquid supplements is of this high value is not known.

Literature Cited

Wohlt, J. E., 1973, J. Dairy Sci. 56:1052.
