Research Note

EVALUATION OF DRIED LIQUID STREPTOMYCES SOLUBLES AS A RUMINANT FEED[1,2]

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Liquid streptomyces solubles (LSS) with a concentration of approximately 30% dry matter (DM) was produced for many years in Illinois and Puerto Rico. It was sold by the pharmaceutical company Abbott Laboratories, Inc. as a feed ingredient, mostly for use with poultry in the continental United States. In Puerto Rico it was marketed, by a local company, combined with cane molasses as a liquid supplement for cattle. However, its high water content made shipping costs expensive; thus the company sought means of processing LSS to produce both a more concentrated liquid and a dry powder. The present research was conducted to evaluate the powder in terms of animal acceptance and digestibility, as LSS was evaluated years ago (Vallejo and Randel, 1982).

Six castrated male sheep of nondescript breed, weighing between 29 and 35 kg, were maintained in three duplex units of individual cages, located on a concrete floor with drainage system, inside a pavilion with partially open side walls. The wooden cages had a fecal collection tray with a screen bottom suspended underneath the slatted floor. The animals were not tied in place but had space to turn around inside their cages, which were open above. Three buckets were located on the outside of each cage accessible to the animal, one of which supplied drinking water; another, coarsely chopped hay of mixed fine-stem tropical grasses (*Dichantium annulatum*) and star (*Cynodon nlemfuensis*); the third contained concentrate feed, which consisted of ground maize (GM) alone in the basal diet or in a mixture with LSS powder (LSS-P) in the test diet.

The first objective was to determine how high a proportion of LSS-P in the LSS-P/GM mixture, when offered as 40% of the ration in addition to chopped grass hay, would be accepted by the animals. Thus, the sheep were offered stepwise at three-day intervals mixtures containing 10, 20, 30 and 40% of LSS-P. The mixtures with up to 30% LSS-P were eaten readily, but the 40% level was unappetizing to most of the animals. A 35% LSS-P mixture was then tested and again a problem of inadequate acceptance was encountered. Therefore, it was decided to use the 30% LSS-P: 70% GM mixture in the digestibility trials.

The theoretical ratio of hay to concentrate selected was 60:40 as fed, thus the three components of the test diet were offered in the proportions 60 hay:28 GM:12 LSS-P. Increases or decreases in voluntary hay intake served as the guide for daily adjustment of total ration offering, which was divided into two equal portions fed morning and afternoon. Uneaten hay or concentrate mixture were reweighed before the morning feeding. Table 1 shows the chemical composition of the three ingredients used.

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TABLE 1.—*Percentage chemical composition of chopped hay, ground maize and LSS powder used in the experiment.*

Component	Dietary ingredients (%)		
	Hay	Maize	LSS Powder
Dry matter	87.68	88.33	95.40
Ash[1]	5.28	1.39	18.20
Crude protein[1]	5.56	8.26	25.38
Neutral detergent fiber[1]	70.70	15.66	7.27

[1]Dry basis.

The digestibility trials consisted of two periods, each of which included 10 days for stabilization of ingestion and digestion, during which time feed was offered in nearly constant daily amounts. Under the same feeding regime, there were seven days for total feces collection. A daily 30% aliquot of feces was composited for each animal and all feeds and orts were sampled for DM determination and composited for subsequent chemical analyses. Analytical methods used were: DM, oven drying at 55 to 60° C for 48 hours; ash and total nitrogen, AOAC (1990); neutral detergent fiber (NDF), Van Soest et al. (1991), as modified by the use of ANKOM Technology equipment. Percentage organic matter (OM) was calculated as 100% - % ash. The second two-week period followed the same procedure as described, except that the LSS-P was eliminated and the basal diet of hay and GM, in the theoretical as fed proportions 60:40, was used.

Feed intake and fecal excretion data were converted to DM basis, and coefficients of digestibility were calculated for individual animals in each period. Assuming the absence of associative effects, and thus that the hay and GM components had the same digestibility in both periods (i.e., that the digestibility determined in period 2 was also applicable to period 1), fecal excretion due to LSS-P was obtained by difference, and an estimate of the digestibility of LSS-P was calculated (Schneider and Flatt, 1975).

One animal that had been eating normally at the start lost its appetite for unknown reasons and consumed very little feed for a number of days. Data obtained from this animal were not usable; thus, digestibility results presented are from five animals.

Table 2 shows the DM digestibilities. The most notable finding here is that the test diet, composed of 58.2% hay, 28.6% GM and 13.2% LSS-P (DM basis), had almost exactly the same mean digestibility as the basal diet, with 59.2% hay and 40.8% GM:DM proportions. The associated standard errors (SE) were quite low (55.7 ± 0.7 vs. 55.6 ± 1.0%). Thus, 13.2% LSS-P DM replaced 12.2% GM and 1.0% hay DM with no loss of digestibility.

The attempt to estimate digestibility of LSS-P alone led to a mean of 56.6%, but there was a wide range of variability in the individual values, as reflected in the standard error (SE) of 11.4%. This variability is not surprising in view of the long extrapolation, from 13.2 to 100%, involved in the indirect calculation of this digestibility. At this level of dietary inclusion of LSS-P, a much larger number of observations would be needed to obtain a reliable mean value with low SE.

Table 2 also summarizes comparative digestibilities of the basal and test diets and LSS-P digestibility estimates with regard to OM, crude protein (CP), and NDF fractions. When OM was used instead of DM, essentially the same results were obtained. In this case, there was a slightly lower digestibility (0.9%) of the test diet than that of the basal (56.1 vs. 57.0%), which led to an appreciably lower estimate of LSS-P digestibility than that which was obtained for DM (56.6 vs. 49.9%).

TABLE 2.—*Mean daily intake, fecal excretion and digestibility coefficients of dry matter, organic matter, crude protein, and neutral detergent fiber of five sheep.*

		Consumption (g)				Fecal excretion (g)			% Diet digestibility[1]	% LSS-P digestibility
		Total	Hay	Maize	LSS-P	Total	Maize	LSS-P		
Dry Matter										
Period 1 (test diet)	Mean	814.9	473.2	233.7	108.0	361.0	314.0	47.0	55.7	56.6
	Std. error	7.1	6.6	1.4	0.7	7.4	6.6	12.2	0.7	11.4
Period 2 (basal diet)	Mean	868.1	513.7	354.4	—	386.1	386.1	—	55.6	—
	Std. error	46.4	28.7	17.8	—	23.3	23.3	—	1.0	—
Organic Matter										
Period 1 (test diet)	Mean	766.9	448.8	217.5	100.5	336.8	286.2	50.5	56.1	49.9
	Std. error	7.2	6.2	1.3	0.6	6.8	6.4	11.4	0.6	11.1
Period 2 (basal diet)	Mean	835.8	486.4	349.4	—	359.7	359.7	—	57.0	—
	Std. error	45.0	27.5	17.6	—	22.6	22.6	—	1.0	—
Crude Protein										
Period 1 (test diet)	Mean	75.8	27.3	33.2	15.3	36.3	35.4	1.0	51.9	93.8
	Std. error	2.3	1.8	0.6	0.3	0.9	1.2	1.4	1.4	9.3
Period 2 (basal diet)	Mean	56.9	27.6	29.3	—	33.1	33.1	—	41.4	—
	Std. error	2.9	1.5	1.4	—	0.7	0.7	—	2.2	—
Neutral Detergent Fiber										
Period 1 (test diet)	Mean	380.6	335.2	31.1	14.4	267.4	248.7	18.6	29.7	-31.4
	Std. error	4.8	4.2	0.8	0.4	5.7	9.7	12.3	1.2	86.8
Period 2 (basal diet)	Mean	416.9	361.5	55.4	—	283.4	283.4	—	32.1	—
	Std. error	22.6	20.3	2.5	—	19.0	19.0	—	2.2	—

[1]Mixture of hay, maize and LSS-P in Period 1 and of hay and maize in Period 2.

The CP fraction merits comment. In this experiment apparent digestibility was determined (as opposed to true digestibility, which must take into account endogenous fecal excretion). The apparent digestibility of CP varies directly with dietary CP level, since the negative effect of the nearly constant endogenous nitrogen excretion per unit of DM intake is diluted in a larger volume of ingested CP (McDonald et al., 1973). Given a CP content in the basal diet consumed in this study (hay plus maize) of only 6.6% in the DM, the addition of any reasonable source of CP would be expected to increase the apparent digestibility of this fraction. LSS-P addition did so to the extent of 10.5 percentage units (51.9 vs. 41.4%). A mean estimate of 93.8% digestibility for the CP fraction of LSS-P was obtained, but this estimate was associated with a SE of 9.3% and should be viewed with caution.

Low estimates of NDF digestibility were obtained for the test and basal diets (29.7 ± 1.2 and 32.1 ± 2.2%, respectively). Since hay supplied most of the NDF, these results suggest a rather lignified and poorly digested fibrous (cell wall) fraction in the hay used. It was not possible to reliably estimate the digestibility of this fraction in the LSS-P, as only one of the five animals yielded a reasonable result, whereas the other four yielded either negative values or values in excess of 100%. The mean NDF digestibility was negative, with an enormous SE. The low concentration (7.3%) of NDF in LSS-P (Table 1) made estimation of the digestibility of this fraction by extrapolation unreliable, and data from only five sheep were far too few for this purpose.

In summary, 12% of LSS-P (as fed basis) effectively replaced part of the GM in a 60 hay: 40 GM diet, all of which could mean a saving of imported concentrate ingredients in commercial practice, if LSS-P were competitively priced. However, not enough data on digestibility of LSS-P alone are available for conclusions.

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