Variation of Esophageal Fistula Samples Between Animals and Days on Tropical Grasslands[1]

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Highlight

Forage collected by esophageal-fistulated cattle varies in chemical composition between days and animals. The number of samples needed for a given degree of accuracy was determined. Silica content of fistula steer feces was significantly different from feces from the non-fistulated steer. There were no significant differences in crude protein, crude fiber, and ether extract.

Many workers (Van Dyne and Torell, 1964) have used esophageal-fistulated animals in sampling forage for chemical and botanical analyses. Individuality in animals, great variety in plant species, and a two-to-threefold difference in nutrients between stems and leaves make collection of a representative sample by this means difficult. In most instances a limited number of fistulated animals have been used, making the determination of degree of variation less reliable. Knowledge of variation among animals and days would be valuable to determine the number of samples necessary to establish a desired degree of accuracy.

Chemical analyses of fecal samples from fistulated and non-fistulated animals would indicate if the fistula causes any abnormality in consumption of nutrients.

FIG. 1. Sanga-type, esophageal-fistulated steers on their way to pasture for a 45-minute period of collecting. Thornbush corral *(boma)* is shown in background. Samples were air dried in metal building at left.

Materials and Methods

Twelve Ankole steers were fistulated as described by Van Dyne and Torell (1964). A month was allowed for healing before forage collections were made. Sampling was done on Days 1, 2, 5, 6, 7, 8, and 10, using all twelve steers. Botanical composition and location of pasture were described by Bredon et al. (1967).

From the time of the operation through Day 10 (40 days) twelve fistulated steers plus ten non-fistulated steers grazed the experimental pasture. As was the native custom, because of predation by lions and other African carnivores, the cattle were corraled each night in a thornbush *boma* and taken to the pasture to graze at about 9 AM. They returned to the *boma* between 5 and 6 PM. Usual management in the area was to herd the cattle; however, in this experiment they were allowed free access to the pasture.

The schedule for the days when fistula collections were made was varied from the normal by putting the steers through a chute and taking a grab sample of feces, removing the esophageal fistula plug, strapping on the solid-bottom collection bag, and herding to the pasture approximately 600 ft from the *boma* through a driveway. The steers were allowed 45 min to graze and were then herded back to the *boma* where the fistula bags were removed. The plugs were inserted and the cattle taken back to the pasture to graze (Fig. 1).

The animals were fed 100 g/head/day of common salt in a hollowed out termite hill near the *boma* each evening.

The fistula samples were squeezed in a cotton cloth. The solid portion was placed on an aluminum tray and air-dried in a metal building. The feces were preserved in polyethylene bags with 5 ml phenol (80%)/200 g of feces.

Chemical analyses were as described by Bredon, et al. (1967). A few samples were not ade-

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quate for chemical analysis due to regurgitation or insufficient sample size. Therefore, missing data were calculated by the method described by Steel and Torrie (1960). All computations were made on an ash-free basis.

Multiple comparisons were made between animals and between days, to determine which means were significantly different by Tukey's test (1953) as described by Steel and Torrie (1960). Number of animals necessary for a specific degree of accuracy was determined by the formula $n = \frac{t^2 s^2}{d^2}$, Snedecor (1956). An analysis of variance was used to compare the chemical composition of the feces of the fistulated and non-fistulated steers.

Table 1. Mean crude protein, crude fiber and ether extract values and multiple comparisons by day for twelve steers.

Item	1	2	5	6	7	8	10
Crude Protein	5.62a*	7.66c	7.27bc	7.14bc	7.28bc	7.03bc	6.65b
Crude Fiber	39.6 a	40.3 a	40.2 a	39.8 a	41.8 a	41.0 a	40.5 a
Ether Extract	1.65ab	1.43a	1.70ab	1.79ab	1.84ab	1.45a	2.17b

* Means followed by the same letter are not significantly different at the 5% level.

Table 2. Animal-days needed for 95% level of accuracy and the coefficient of variation for these nutrients.

Item	Forage Composition Percentage	Accuracy of Prediction	Animal-Days	Coefficient of Variation
Crude Protein	7.0	± 10% Mean	5.6	8.25
Crude Fiber	40.0	± 5% Mean	4.1	4.62
Ether Extract	1.7	± 10% Mean	28.7	22.50

Results and Discussion

The ingesta contained varying amounts of saliva as demonstrated when the ingesta was separated into liquid and solid portions. The ratio by weight of liquid to solid was 4.1 with S.D. 3.3 and a range from 1.4 to 19.6. Such a variation in the amount of saliva would cause great variation in nitrogen content of ingesta.

The squeezed solid sample was air-dried and the ratio of the weight before and after drying was 3.5 with S.D. 0.3. The air-dried sample was taken to the laboratory for oven drying and chemical analysis. Unfortunately the samples were not weighed before grinding so the dry matter content of the squeezed and the air-dried samples could not be calculated. Therefore, following computations are based on 100% D.M. basis of the solid portion only.

Variation Between Day and Animal.—Table 1 shows mean crude protein, crude fiber, and ether extract values, as well as multiple comparisons by day, for 12 steers.

Protein value for Day 1 is significantly lower than the other collection days. There is a declining trend from Day 2 through Day 10 with only the 1st, 2nd, and 10th days' values significantly different. This would indicate that the forage was maturing with a subsequent decrease in crude protein or that the animals were becoming less selective; however, the steers had been in the pasture for 30 to 40 days. The steers were fitted with the collection bags for the first time on Day 1 and the strangeness of the procedure may have changed their grazing habits.

There were no significant differences in the crude fiber values for any day.

Ether extract showed some differences that were significant at the 5% level, however, there was no trend to this difference.

Differences between animals were not significant at the 5% level for crude protein, crude fiber or ether extract.

Table 2 presents the number of animal day samples needed to predict at the confidence level within ± 10% of the mean for crude protein and ether extract and ± 5% of the mean for crude fiber. Since there were no significant differences between animals and very little difference between days, the total number of animal days is the item to be considered. Juko and Bredon (1961), in their comparison of analyses of leaves and the whole plant of some common Uganda grasses, show that there is much wider variation in herbage in tropical areas than in temperate areas. In locations where less variation exists, animal numbers may be reduced for the same degree of accuracy. Work conducted by Arnold[3] with esophageal-fistulated cattle and sheep substantiated our determinations of coefficient of variation for crude protein and crude fiber.

Fecal Variations.—If esophageal-fistulated steers had a depraved appetite due to the fistulation, this difference should show up in differences in the chemical composition of fecal samples.

It was noted that the fistulated steers spent a considerable amount of time at the salt trough. This was probably due to a loss of sodium in the saliva via the fistula plug. An analysis of variance showed that the fistulated steers' feces were significantly higher ($P<0.01$) in silica than those of the non-fistulated steers although there were no significant differences between days nor between animals. The means were 18.4 and 14.5%. This increased silica can probably be attributed to soil taken from the salt-saturated termite hill.

[3] *Arnold, G. W. 1966. Personal communication.*

Table 3. Significant differences between treatments, days and animals for chemical analysis of fecal crude protein, crude fiber and ether extract.

Item	Crude Protein	Crude Fiber	Ether Extract
Treatment	N.S.	N.S.	N.S.
Days	.01*	N.S.	.01
Animals	.01	.05	.001

* Level of probability.

Table 3 presents results of an analysis of variance of fecal chemical analyses. Crude protein, crude fiber, and ether extract fecal results are presented on an ash-free basis because of silica contamination. There were no significant differences between fistulated and non-fistulated steers in these three constituents.

There were significant differences ($P<0.01$) in crude protein between days and between animals. Crude fiber showed no significant difference between days but differences ($P<0.05$) between animals. As with the fistula ingesta samples the ether extract in the fecal samples was variable, with significance of $P<0.01$ and $P<0.001$ between days and animals respectively.

Table 4 shows a comparison of crude protein, crude fiber, and ether extract composition of the ingested fistula samples and the fecal samples.

Table 4. Comparison of percent crude protein, crude fiber, and ether extract composition of the ingested fistula samples and the fecal samples.

	Crude Protein	Crude Fiber	Ether Extract
Fistula Ingesta	6.95	40.45	1.72
Fecal-Fistulated	9.14	32.40	3.58
Fecal-Non-Fistulated	9.00	32.20	3.68

Summary and Conclusion

Twelve indigenous Sanga cattle fitted with esophageal fistulas were used to collect tropical forage on 7 different dates within a 10-day period. Chemical analyses for crude protein, crude fiber, ether extract, and ash were determined on each sample.

Analysis of variance showed no significant differences between animals for crude protein, crude fiber, and ether extract. There were significant differences between days for crude protein and ether extract but not for crude fiber. The number of animal-days needed for a 95% level of accuracy and to come within $\pm$ 10% of the mean was 5.6 for crude protein and 28.7 for ether extract. Crude fiber would need 4.1 animal-days to come within $\pm$ 5% of the mean.

A depraved appetite for salt in the fistulated cattle and the subsequent consuming of salt-saturated soil appeared to be the cause of a significantly higher silica level in the feces of these steers as compared with non-fistulated steers.

Fecal crude protein, crude fiber, and ether extract, when expressed on an ash-free basis, showed no significant differences between fistulated and non-fistulated steers. There were significant differences between animals and between days.

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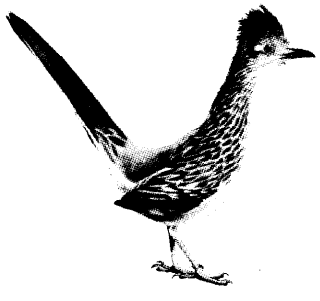

BY-LAW PROPOSALS FAIL

The two proposed changes in By-laws for (1) creation of the honorary status of Fellow, and (2) requiring petitions for nomination of candidates for Society offices to have 75 signatures of members of two or more Sections, failed to receive the necessary two-thirds approval of voting members.