

ANALYSIS OF FRESH EXCRETA IN THE DETERMINATION OF APPARENT DIGESTIBILITY COEFFICIENTS

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In the determination of the apparent digestibility of feed nutrients by the usual methods, it is necessary to determine the amount of food eaten and of feces excreted by an animal during an experimental period of several days. Modified procedures have been suggested from time to time to simplify this work, while little attention has been given to the simplification of procedures employed in making an accurate chemical analysis of aliquoted samples of feed and feces. In fact, the nature of the problems that arise in digestibility studies with ruminants tends to divert the attention of investigators away from simplified procedures toward more complex ones—methods designed to give a better indication of the true composition of the feces than does the percentage of crude protein, fiber, ether-extract, and nitrogen-free extract as expressed in a proximate analysis. Assumptions on which the results of digestion experiments are based and the several factors known to modify these results have accounted for the expression "apparent digestibility" to indicate that the numerical value so expressed is not the true digestibility. The obvious difference between the composition of feeds and that of feces, despite their apparent similarity when the composition of both is given in a proximate analysis, has also contributed to the development of this term. Nevertheless, the system of reporting digestibility coefficients based on the results of proximate analysis still prevails and these values when properly interpreted and applied continue to give useful information about a feed.¹

Crude protein determinations when made on dried feces give consistently low results because of the loss of volatile nitrogenous constituents in drying. This determination, therefore, is usually made on thoroughly mixed fresh or preserved samples. When protein is the only constituent under investigation, this procedure allows a large number of determinations to be handled with ease, whereas drying and grinding the sample

¹Failure to recognize the limitations and true significance of data acquired in this manner has occasionally led to some surprising statements about the digestibility of specified nutrients in a ration. The term "crude protein", for example, although used to signify true protein plus a limited amount of non-protein nitrogen in feeds, when applied to fecal analysis actually includes all nitrogenous material capable of being broken down to ammonia in the process of chemical analysis. This so-called protein in the feces of ruminants may bear little if any chemical relationship to the protein originally present in the feed. Only in part does it represent the undigested residue of a particular food protein even under conditions of liberal protein intake. There are, of course, instances in which physical factors and the presence of non-protein material tend to protect protein from the action of digestive enzymes and bacteria, as for example in the passage of certain whole grain cereals through the digestive tract practically unaltered. In such instances, undigested food protein makes up an appreciable part of the total nitrogen of the feces.

Caution should likewise be used in treating ether-extract as fat since a large part of the ether-extract of feeds, especially forage, is made up of plant pigments and non-saponifiable material rather than true fat. In a proximate analysis of feces, a determination of ether-extract is necessary in order to arrive at a value for nitrogen-free extract by difference. Attempts to attach significance to the results in terms of digestibility without giving consideration to the composition of the fat-soluble material, however, are largely superficial for the reason that the ether-extract of feces is probably more closely related to blood and tissue lipids and excretory products of the digestive tract than to undigested food fat. Further, negative digestibility coefficients through the conversion of carbohydrates to fat and the excretion of endogenous fat soluble material are not unusual under ordinary circumstances and are in keeping with present knowledge of lipid metabolism in ruminants.

as ordinarily done for more complete analysis frequently presents some difficulty. In fact, the most disagreeable feature of the analysis is the dust produced in the grinding and mixing of large samples of dry feces. Preliminary attempts to make a proximate analysis on fresh samples have met with success and are reported here.

The feces were from eight steers being fed dry grass. Feces collections were made twice daily, and after mixing, aliquots were preserved with thymol in sealed jars in an electric ice box. At the end of a digestion period of 10 days or less, the aliquots were remixed and triplicate 10-gram samples of each weighed out for protein determinations, and quadruplicate 10-gram samples weighed into crucibles for moisture, ash, ether-extract, and crude fiber. The latter 10-gram samples were dried for moisture determination and half of these used for the determination of ash. The remaining duplicates were ground in a glass mortar and transferred quantitatively to extraction thimbles for determinations of ether-extract. The residues from the ether extraction were used for the determination of crude fiber.

Duplicate 250-gram samples of the fresh feces were dried to constant weight, ground, and brought to an air-dry condition. Proximate analyses were carried out on 2-gram samples of this material in the usual manner.

A comparison of the results obtained by the two procedures indicates that the same degree of accuracy is obtained when the analysis is made on 10 grams of the fresh sample as when made on 2 grams of the ground air-dry samples. The difference between the results obtained by the two procedures was no greater than the differences between duplicates of the air-dry samples. Daily moisture determination made at the time of collection, and after the aliquots had been thoroughly mixed for analysis, showed no appreciable loss of moisture in storage or mixing. Nitrogen losses which occurred in drying the feces amounted to about 5 percent. The method of analysis of fresh samples proved sufficiently accurate and expedient to warrant further investigations which are now in progress with steers on various rations.
