NITROGEN BALANCE WITH STEERS ON OIL-MEAL RATIONS

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Oil meals produced from oil bearing seeds by hydraulic and expeller processes have been used extensively as protein supplements in livestock rations. When large quantities of solvent-processed oil meals became available for feeding, a question was raised as to the nutritive value of the protein in the meals produced by the different processes. Therefore an investigation was undertaken to determine, by nitrogen balance trials with steers, the

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comparative value of the protein in rations containing hydraulic, expeller and solvent-processed meals. Preliminary results are reported here.

The meals selected for investigation were commercially produced hydraulic and solvent-extracted cottonseed meal, and expeller and solvent-extracted soybean oil meal. It is recognized that these commercial products will vary somewhat in composition since the heat treatment employed in processing hydraulic and expeller meals is usually varied to secure maximum oil yield. Heat alters the physical properties of protein and alters its nutritive value for some animals.

PROCEDURE

The meals were used as supplements to prairie hay in maintenance rations and as supplements to corn and hay in fattening rations. On a dry matter basis the daily maintenance rations contained 3745 gm of hay and from 440 to 573 gm of oil meal supplement; the daily fattening rations contained 1684 gm of hay, 4083 gm of corn and from 356 to 476 gm of oil meal supplement. The maintenance rations containing soybean oil meal were supplemented daily with 15 gm of $NaH_2PO_4 \cdot H_2O$.

Differences in proximate composition between the maintenance and fattening rations were largely accounted for by differences in their content of crude fiber and N.F.E. (soluble carbohydrates). The fattening rations contained about 71 per cent N.F.E. and 11 per cent of crude fiber, whereas the maintenance rations contained about 50 per cent N.F.E. and 31 per cent of crude fiber. The protein content of all rations was adjusted to agree within about 10 per cent by varying the amount of oil meal supplement; consequently, rations made up with a high protein meal were fed in slightly smaller amounts than those made up with a meal of lower protein content. These differences in feed allowance, most apparent among the maintenance rations, could have been overcome by further ration adjustments, although this would not be the general practice in maintenance feeding. The oil meals supplied about 60 per cent of the total nitrogen in the maintenance rations but only about 28 per cent of that in the fattening rations. Corn supplied 62 per cent of the total nitrogen in the fattening rations.

The rations were fed to four yearling Hereford steers in individual metabolism stalls which provided for the separate collection of urine and feces. Feces and urine were collected daily during the last 10 days of 20-day feeding periods. There were no feed refusals. The schedule of feeding the rations was so arranged that during any one period each of the four steers received a different ration until all steers had received all rations.

The apparent digestibility of nutrients in the rations was calculated from the results of chemical analysis of the feeds and feces. The amounts of nitrogen retained by the steers on the different rations were calculated as the difference between the nitrogen intakes and the nitrogen excreted in the feces and urine.

RESULTS AND DISCUSSION

From the results presented in Table 1 it is obvious that the apparent digestibility of all nutrients except crude fiber was greater in the fattening rations than in the maintenance rations. The lower digestibility of crude fiber in the fattening rations is possibly related to activity and type of organisms predominating in the paunch when large amounts of readily fermentable carbohydrates are present in the feed. There were no significant differences in nutrient digestibility between similar rations made up with the two cottonseed meal concentrates or between similar rations made up with the two soybean oil meal concentrates. The general trend of digestibility values favored the soybean oil meal concentrate in both maintenance and fattening rations.

The amount of nitrogen retained by the steers was about the same on each of the maintenance rations and on each of the fattening rations. It is of particular interest to note, however, that the fattening rations which supplied daily about 1.6 times as much nitrogen as the maintenance rations permitted nitrogen storage over three times that of the maintenance rations. Although differences in composition of the two types of rations prevent final interpretation of these results, increased feed intake and the nitrogen-sparing action of carbohydrates may account for the more efficient utilization of the nitrogen in the fattening rations. It is known that the addition of carbohydrate to roughage rations has a favorable effect on nitrogen retention, and that protein nitrogen is wasted when carbohydrates are lacking in the ration. It is an interesting possibility that protein nitrogen frequently is wasted in feeding for maintenance under practical conditions and that under such conditions protein can be replaced in part by carbohydrates without effecting an unfavorable change in the nitrogen balance of the animal. In wintering steers on dry grass, for example, a concentrate feed with a protein-carbohydrate ratio of 1:3 might successfully replace an equal amount of a more commonly used protein concentrate having a ratio of about 1:1. The comparative value of different high energy feeds in sparing the nitrogen (protein) in ruminant rations is being further investigated. The results of these studies will be published in detail elsewhere.

SUMMARY

Cottonseed meal produced by hydraulic and solvent processes and soybean oil meal produced by expeller and solvent processes were compared as protein supplements in maintenance and fattening rations for steers. The meals were added to each type of ration on an equivalent protein basis in amounts which supplied 60 per cent of the total protein in the maintenance ration of prairie hay and oil meal, and 28 per cent of the total protein in the fattening ration of prairie hay, corn and oil meal. All rations contained about 10 per cent protein.

The apparent digestibility of all nutrients except crude fiber was greater in the fattening rations than in the maintenance rations, the trend of digestibility values slightly favoring the rations containing soybean oil meal. No significant differences were found in the nutritive value of the protein of the different meals as measured by nitrogen retention. Approximately 16 per cent of the total nitrogen in the maintenance rations and 32 per cent of the total nitrogen in the fattening rations were retained.

TABLE I

Apparent Digestibility of Nutrients in the Different Rations and the Amounts of Nitrogen Retained by Steers Fed These Rations

	PERCENTAGE APPARENT DIGESTIBILITY						NITROGEN BALANCE (GM)			
RATION DESIGNATION	DRY MAT.	ORGANIC MAT.	PROT.	ETHER EXTR.	CRUDE FIBER	N.F.E.	INTAKE	FECES	URINE	RETAINED
MAINTENANCE										
C.S.M. (Hyd.)	62.3	65.1	56.7	58.8	71.2	63.3	69.8	30.1	26.4	13.4
C.S.M. (Sol.)	60.8	63.4	56.6	52.2	68.7	62.1	68.5	29.6	27.3	11.6
S.B.M. (Exp.)	63.6	66.2	63.6	56.9	72.6	63.3	67.8	24.6	32.0	11.2
S.B.M. (Sol.)	63.2	65.9	61.4	46.5	73.0	63.3	66.2	25.5	29.9	11.2
FATTENING										
C.S.M. (Hyd.)	73.8	75.1	63.4	76.3	56.6	78.7	112.8	41.4	36.5	34.9
C.S.M. (Sol.)	72.1	73.5	60.3	72.1	57.9	77.7	114.3	45.5	32.5	36.3
S.B.M. (Exp.)	75.5	76.8	64.3	71.6	62.6	81.3	111.7	40.0	36.6	35.1
S.B.M. (Sol.)	75.6	77.2	65.5	71.0	65.3	81.2	112.4	39.7	37.1	35.6