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Protein Evaluation of Porcine Meat and Bone Meal Products

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Commercially available porcine meat and bone meal products vary in apparent and true nitrogen digestibility as well as in concentration of crude, metabolizable, and undegradable intake protein.

Summary

Thirteen commercially available porcine meat and bone meal products from both independent renderers and commercial packing plants were evaluated in a lamb-digestion study for the following variables: crude protein, undegradable intake protein, metabolizable protein, apparent nitrogen digestibility and true nitrogen digestibility. As a whole, the products varied widely with respect to all of the variables measured with the exception of apparent nitrogen digestibility, indicating that feeding value of commercially available meat and bone meal products also varies widely, although all of the products tested had acceptable protein digestibilities.

Introduction

The recent government ban on feeding rendering products of ruminant origin back to ruminants has led to the development of porcine-only meat and bone meal (MBM) products to be fed to ruminants. Meat and bone meal is high in undegradable intake protein relative to soybean meal and improves performance in growing steers fed forage-based diets sufficient in degradable intake protein. Byproduct feedstuffs are variable due to source differences in processing conditions and raw materials. Variable quantities of raw materials (bone, hair, viscera and meat trimmings) influence both quantity and quality of protein. Processing conditions and production situations vary considerably within the rendering industry and influence the consistency of commercial MBM. Renderers apply heat to drive off moisture, extract fat and eliminate bacterial contamination from animal tissues. Ultimately, this cooking process enhances the resistance to microbial degradation in the rumen. The objective of this experiment was to determine the variability that exists among commercially available porcine MBM products in crude (CP), metabolizable (MP), and undegradable intake protein (UIP) and apparent (AND) and true nitrogen digestibility (TND).

Procedure

Twenty-nine crossbred wether lambs (84 lb) were used in a digestion study consisting of three periods. Lambs were fed a common basal diet (Table 1) at an equal percentage (2.3%) of body weight on a DM basis. The basal diet was formulated to contain a minimum of 10%

Table 1. Composition of basal diet.

Ingredient	% of diet DM
Cottonseed hulls	72.3
Dehydrated alfalfa pellets	15.0
Molasses	5.0
Dry-rolled corn	2.7
Supplement	5.0
Finely ground corn	2.325
Urea	1.204
Ammonium chloride	.500
Salt	.400
Dicalcium phosphate	.316
Ammonium sulfate	.170
Trace mineral premix	.040
Vitamin premix	.030
Selenium premix	.015

Table 2. Concentrations of crude (CP), undegradable intake (UIP), and metabolizable (MP) protein and percentage apparent (AND) and true (TND) nitrogen digestibility of thirteen porcine meat and bone meal products.

Product Number	CP[a]	UIP[ab]	MP[ac]	ASH[a]	AND[a]	TND[a]
1	54.6	41.5[de]	19.5	29.2	62.1[de]	78.0[de]
2	56.0	46.4[ef]	27.3	26.6	63.0[def]	80.9[def]
3	63.0	53.3[g]	33.5	26.7	62.5[def]	80.2[def]
4	54.8	63.0[h]	38.7	29.1	61.5[d]	75.7[d]
5	59.7	53.8[g]	31.4	21.4	62.0[de]	77.6[de]
6	60.9	50.7[fg]	27.7	21.3	61.9[d]	77.0[d]
7	65.5	52.2[g]	40.3	25.5	64.8[g]	88.1[g]
8	64.7	52.5[g]	36.3	24.8	63.7[efg]	83.8[efg]
9	62.9	49.7[fg]	30.7	29.3	63.0[def]	81.0[def]
10	53.5	48.6[fg]	30.2	27.8	63.0[def]	81.6[defg]
11	54.9	39.7[d]	21.5	24.8	63.2[defg]	81.8[defg]
12	61.9	49.3[fg]	28.2	28.3	62.2[de]	78.9[de]
13	60.5	45.6[ef]	32.1	25.9	64.1[fg]	86.5[fg]

[a]CP and ASH as percentage of DM; UIP and MP as percentage of CP; AND and TND as percentages.
[b]Measured by the ammonia release procedure.
[c]MP = UIP - (100-TND).
[defgh]Values within a column with unlike superscripts differ (P < .10).

CP, .42% Ca and .18% P. Urea was included to ensure rumen ammonia did not limit digestion. Thirteen commercially available porcine MBM products were obtained for protein evaluation. The MBM products represented various rendering sources, including both independent renderers and commercial packing plants. Either three or four lambs in each period were fed only the basal diet and served as the urea control. The remaining lambs consumed the basal diet at the same percentage of body weight as control lambs and were supplemented with an additional 3.75% of the basal diet DM as units of CP from one of the MBM products. Treatment diets were isonitrogenous and each treatment contributed 25% of the total N intake for treatment lambs.

The trial consisted of three, 14-day periods. Each period included seven days of dietary adaptation and seven days of total fecal collection. Lambs were housed in individual pens during dietary adaptation and individual metabolism crates during fecal collection. Lambs were reassigned randomly to another treatment at the end of each period. The amount of basal diet offered to each lamb was adjusted based on the average of weights taken on two consecutive days at the beginning of each period.

Feed, feces and orts were dried for 48 hours in a forced air oven at 140°F and analyzed for DM and N. Apparent nitrogen digestibility was calculated as (N consumed - N excreted)/ N consumed. The following formula was used to calculate TND of each MBM product: ((A - (B*C)) / D)*100; where: A = apparent digestibility of N in total diet; B = apparent N digestibility of urea control; C = proportion of total N in diet supplied by basal diet; D = proportion of total N in diet supplied by treatment.

The UIP concentration of the treatment sources was estimated by the *in vitro* ammonia release procedure. Rumen fluid was collected from a ruminally fistulated steer and strained through four layers of cheesecloth. A bicarbonate buffer solution was added to the rumen fluid and 30 ml of the fluid mixture were added to test tubes containing enough sample to provide 20 mg of N. Six tubes were incubated for each sample. Tubes were stoppered and incubated for two time periods (three for 18 hours and three for 24 hours) at 102°F. The ammonia concentration in the fluid of each tube was used to calculate UIP relative to standards whose *in vivo* UIP concentrations have been measured.

The MP (% of CP) for each MBM product was calculated from the UIP concentration and TND measurements where: MP = UIP - (100-TND). This value equals the percentage of N that escapes ruminal degradation and is digested in the small intestine.

Results

Estimates of CP, UIP, MP, ASH, AND and TND are shown in Table 2. Concentrations of CP ranged from 53.5 to 65.5%. Undegradable intake protein concentrations ranged from 41.5 to 63.0% of CP. The UIP content of product 4 was higher (P < .10) than all of the other products. Metabolizable protein estimates ranged form 19.5 to 40.3%. Ash values ranged from 21.3 to 29.3% of DM. Apparent nitrogen digestibility values ranged from 61.5 to 64.8%. Products 7 and 13 were similar in AND (64.8 and 64.1%, respectively) and were significantly higher (P < .10) in AND than products 1, 4, 5, 6, and 12. True nitrogen digestibility values ranged from 75.7 to 88.1%. Products 7 and 13 had the highest TND (88.1 and 86.5%, respectively) and were significantly higher (P < .10) in TND than products 1, 4, 5, 6, and 12.

The 13 MBM products used in this trial are representative of both independent renderers and commercial packing plants. As such, inputs (deadstock, tankage, meat trimmings and bones, amount of hair) are variable and contribute to the variability observed in the feeding value of the products. Likewise, processing systems and conditions differ among processors. The exact processing conditions of each product are not known. This trial demonstrates the variability that exists among commercially available porcine meat and bone meal products. Although these results indicate all of the porcine MBM products tested have relatively similar CP contents and adequate protein digestibilities, the range in MP values indicates the products may have large differences in feeding value for ruminants.

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