RUMINAL UNDIGESTIBLE INTAKE PROTEIN VALUE AND POST RUMINAL DIGESTIBILITY OF MENHADEN FISH MEAL VERSUS TWO HIGH-BYPASS ANIMAL PROTEIN BLENDS IN AN 88% CONCENTRATE FINISHING DIET FOR FEEDLOT CATTLE

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ABSTRACT: Four Holstein steers (466 kg) with cannulas in the rumen and proximal duodenum were used in a 4 X 4 Latin square design experiment to evaluate the ruminal escape protein value and post ruminal digestibility of menhaden fish meal (FM) vs two high-bypass protein blends in an 88% concentrate finishing diet. Blend 1 (B-1) contained 5% fish meal, 25% meat and bone meal, 20% blood meal, and 50% hydrolyzed feather meal. Blend 2 (B-2) contained 55% meat and bone meal, 25% blood meal, 10% fishmeal, and 10% feather meal. Ruminal OM digestion was similar for FM, B-1, and B-2 supplemented diets. However, total tract OM digestion was greater ($P < .10$) for FM than for the protein blends. This difference was due to a 5.0% greater ($P < .10$) post ruminal OM digestibility for the FM supplemented diet. Ruminal digestible intake protein was greater ($P < .01$) for FM than for the protein blends. Ruminal indigestible intake protein values averaged 52, 69, and 71%, for FM, B-1 and B-2, respectively. Post ruminal protein digestibility was greater ($P < .05$) for FM than for the protein blends. Post ruminal protein digestibility was greater (5%, $P < .10$) for the B-2 than for the B-1 supplemented diets. Post ruminal protein digestibilities of FM, B-1, and B-2 were 95.7, 77.6, and 87.0%, respectively.

Introduction

Most of the information regarding the UIP value of FM was obtained in ruminants fed high-forage diets growing diets (NRC, 1985; Willms et al, 1991; Petit and Flipot, 1992; Veira et al, 1994). The objectives of the present study was to evaluate the UIP value of FM and two high-bypass protein blends in steers fed a high-concentrate finishing diet.

Experimental Procedures

Four Holstein steers (466 kg) with cannulas in the rumen and proximal duodenum (approximately 6 cm from the pyloric sphincter) were used in a 4 X 4 Latin square design experiment. Dietary treatments are shown in Table 1. Calves were maintained in individual pens with access to water at all times. Diets were fed at 0800 and 2000 daily. Experimental periods were 2 wk, with 10 d of diet adjustment and 4 d of collection. During collection, duodenal and fecal samples were taken twice daily as follows: d 1, 0750 and 1350; d 2, 0900 and 1500; d 3, 1050 and 1650 and d 4, 1200 and 1800. Upon completion of the trial, approximately 500 ml of ruminal fluid was obtained from each steer, composited across diets, and bacteria were isolated via differential centrifugation. Feed, microbial, duodenal and fecal samples will be subjected to all or part of the following analyses: DM, oven drying at 65° C; ash, Kjeldahl N, ammonia N (AOAC, 1975); Purines (Zinn and Owens, 1986); chromic oxide (Hill and Anderson, 1958) and amino acids (Beckman 6300 amino acid analyzer). Microbial synthesis was based on the purine:N ratio of the bacterial isolate and the purine concentration of duodenal chyme (Zinn and Owens, 1986). Organic matter fermented in the rumen (OMF) was considered equal to organic matter (OM) intake minus the difference between the amount of OM reaching the duodenum and microbial OM. Feed N escaping ruminal degradation was considered equal to total N leaving the abomasum minus ammonia and microbial N and, thus, includes endogenous contributions. The trial will be analyzed as a 4 X 4 Latin square design experiment (Hicks, 1973). Treatment effects were tested using the following orthogonal contrasts: 1) tapioca vs FM, B-1, and B-2; 2) FM vs B-1 and B-2; and 3) B-1 vs B-2.

Implications

Menhaden fishmeal has an undegradable intake protein value of 52%, and a post ruminal true protein digestibility of 96%. Compared with other high-bypass animal protein sources, fishmeal is uniquely high in escape methionine and lysine, and low in escape phenylalanine.

Table 1. Composition of diets fed to steers

Item	Treatments			
	Basal	FM	B-1	B-2
Ingredient composition, % (DM basis)				
Alfalfa hay	6.00	6.00	6.00	6.00
Sudangrass hay	6.00	6.00	6.00	6.00
Flaked barley	38.00	38.00	38.00	38.00
Flaked corn	20.00	20.00	20.00	20.00
Cane molasses	4.00	4.00	4.00	4.00
Yellow grease	7.50	7.50	7.50	7.50
Tapioca	15.00			
Fishmeal[a]		15.00	.75	1.50
Meat meal			3.75	8.25
Blood meal			3.00	3.75
Feather meal			7.50	1.50
Urea	1.00	1.00	1.00	1.00
Limestone	1.60	1.60	1.60	1.60
TM salt[b]	.50	.50	.50	.50
Chromic oxide	.40	.40	.40	.40

[a]Menhaden.

[b]Trace mineral salt contained: $CoSO_4$, .068%; $CuSO_4$, 1.04%; $FeSO_4$, 3.57%; ZnO, .75%; $MnSO_4$, 1.07%; KI, .052%; and NaCl, 93.4%.

Table 2. Influence of dietary treatment on characteristics of digestion

Item	Treatments Basal	FM	B-1	B-2	SD
Intake, g/d					
DM	6,054	6,071	6,061	6,074	
OM	5,670	5,553	5,646	5,535	
N	110	209	225	209	
Leaving abomasum, g/d					
OM[a]	2,678	2,918	2,947	3,091	154
Nonammonia N[bc]	123.2	166.6	190.9	183.7	11.1
Microbial N	85.4	77.4	73.8	75.7	10.4
Feed N[bd]	37.9	89.2	117.1	108.0	8.3
Fecal excretion, g/d					
OM[e]	1,101	1,069	1,188	1,176	76
N[bdf]	34.0	34.0	48.6	40.5	1.6
Ruminal digestion, % intake					
OM[b]	67.8	61.4	60.9	57.8	3.0
Feed N[bd]	65.6	57.4	47.9	48.3	3.7
MN efficiency[g]	22.4	22.7	21.5	23.9	2.6
Post ruminal digestion, % leaving abomasum					
OM[eh]	58.7	63.4	59.3	61.4	2.1
N[bci]	73.7	80.7	75.3	79.0	1.7
Total tract digestion, %					
OM[e]	80.6	80.7	79.0	78.7	1.3
N[bd]	69.1	83.8	78.4	80.6	1.7

[a]Tapioca vs fish meal, Blend 1, and Blend 2 ($P < .05$).
[b]Tapioca vs fish meal, Blend 1, and Blend 2 ($P < .01$).
[c]Fishmeal vs Blend 1 and Blend 2 ($P < .05$).
[d]Fishmeal vs Blend 1 and Blend 2 ($P < .01$).
[e]Fishmeal vs Blend 1 and Blend 2 ($P < .10$).
[f]Blend 1 vs Blend 2 ($P < .01$).
[g]Microbial N, g/kg of OM fermented.
[h]Tapioca vs fishmeal, Blend 1, and Blend 2 ($P < .10$).
[i]Blend 1 vs Blend 2 ($P < .10$).

Table 3. Influence of dietary treatments on amino acid supply to the small intestine

Item	Treatments				SD
	Tapioca	FM	B-1	B-2	
Entering small intestine, g/d					
Dispensable Amino acid					
Alanine[abc]	43.4	57.2	57.6	65.8	2.9
Aspartic acid[a]	66.1	89.7	87.2	91.9	4.3
Glutamic acid[a]	91.7	123.6	124.7	123.0	5.9
Glycine[acd]	36.1	51.4	68.4	63.5	3.0
Proline[ace]	29.8	39.4	67.2	53.4	2.6
Serine[ace]	28.5	37.4	71.6	48.9	2.7
Tyrosine[a]	28.9	36.7	38.1	37.0	1.8
Indispensable amino acids					
Arginine[aef]	29.6	44.5	54.3	48.5	2.4
Histidine[ad]	12.9	19.2	15.8	23.5	1.0
Isoleucine[ad]	31.9	41.0	45.8	39.2	3.8
Leucine[ae]	53.4	70.9	85.0	84.6	3.9
Lysine[ace]	43.6	63.5	46.3	61.3	2.7
Methionine[aef]	11.5	19.4	12.9	14.8	.7
Phenylalanine[ae]	29.5	39.4	45.8	46.4	2.1
Threonine[ab]	32.6	42.3	47.5	45.3	2.2
Valine[ace]	37.6	48.8	66.1	56.5	2.8

[a]Tapioca vs fishmeal, Blend 1, and Blend 2 ($P < .01$).
[b]Fishmeal vs Blend 1 and Blend 2 ($P < .05$).
[c]Blend 1 vs Blend 2 ($P < .01$).
[d]Blend 1 vs Blend 2 ($P < .10$).
[e]Fishmeal vs Blend 1 and Blend 2 ($P < .01$).
[f]Blend 1 vs Blend 2 ($P < .05$).