

Ruminal degradability and intestinal digestibility of protein and amino acids in NovaMeal and other common soybean and corn protein sources

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A study was conducted to compare ruminal degradation and intestinal digestibility of protein and amino acids of different protein sources (NovaMeal, as well as common soybean and corn protein sources), using in situ and in vitro techniques.

KEY STUDY RESULTS

- NovaMeal had the greatest RUP and lowest RDP of the protein sources evaluated.
- NovaMeal had the greatest RUPD (RUP digestibility) of the protein sources evaluated.
- NovaMeal had the lowest ruminal degradation of methionine. Intestinal digestibility of methionine did not differ by source, suggesting greater intestinal absorption of methionine from NovaMeal.
- Lysine content both after rumen incubation and intestinal digestibility of lysine were greatest for soybean sources vs. corn sources. However, the amount of lysine absorbed intestinally did not differ between NovaMeal and soybean meal.
- These results suggest that methionine and lysine availability can be comparable between soybean and corn sources, and one must look further than amino acid composition of the feedstuff when evaluating feeds for a diet.

MATERIALS & METHODS

- 3 lactating dairy cows were used for the in situ procedure. Samples of each feedstuff were put into Dacron nylon bags, heat sealed, and incubated in duplicate in the rumen of each cow for 0, 2, 4, 8, 16, 24, and 48 hours.
- Intestinal digestibility of RUP was determined using the modified three-step procedure (Gargallo et al., 2006). Briefly, residue from the in situ bag was placed in a pepsin solution for 1 hour and a pancreatin solution for 24 hours within a Daisy incubator, an in vitro system that constantly rotates the solution and bags. The residues remaining after the pepsin/pancreatin digestion were used to estimate intestinal digestibility of the RUP (or RUPD).
- Amino acid composition of the initial feeds and residues were determined via ultra performance liquid chromatography.

STATISTICS

- In situ degradation curves of CP were fitted to a nonlinear model. Lag time was negligible for all feedstuffs, so the model without lag time was utilized.
- Degradation constants of CP were estimated using NLIN procedure of SAS.
- In situ degradation constants were analyzed using the MIXED procedure of SAS for each feedstuff with cow as the random variable.
- Mean comparison test (Tukey) was utilized for comparing the feedstuffs to one another.

TRIAL DESIGN

Seven protein sources of soybean or corn origin were evaluated.

- Soybean origin:
 1. Solvent extracted soybean meal (SBM; 49.6% CP)
 2. Expeller soybean meal (ESBM; 48.7% CP)
 3. Extruded soybeans (ES; 37.3% CP)
- Corn origin:
 1. Distillers dried grains with solubles (DDGS; 30.8% CP)
 2. Reduced-fat distillers dried grains with solubles (RFDGS; NovaMeal; 34.0% CP)
 3. High-protein distillers dried grains (HPDG; 41.5% CP)
 4. Modified wet distillers grains with solubles (MWDGS; 29.7% CP)



STUDY RESULTS

- NovaMeal had the greatest RUP and lowest RDP of the protein sources evaluated ($P < 0.05$; Table 1).
- NovaMeal had the greatest RUPD numerically (Table 1). RUPD is the portion of RUP that is digestible and available for absorption in the small intestine.
- NovaMeal and had a greater RUPD than soybean meal, extruded soybeans, distillers grains and modified wet distillers grains ($P < 0.05$; Table 1).

Table 1. Ruminal degradability and intestinal digestibility of protein sources¹

	NM	SBM	ESBM	ES	DDGS	HPDG	MWDGS	SEM
CP (%DM)	34.0	49.6	48.7	37.3	30.8	41.5	29.7	
RDP (%CP)	39.6 ^e	67.7 ^a	46.3 ^d	52.0 ^c	47.7 ^{cd}	45.5 ^d	61.7 ^b	2.48
RUP (%CP)	60.4 ^a	32.3 ^e	53.7 ^b	48.0 ^c	52.3 ^{bc}	54.5 ^b	38.3 ^d	2.48
RUPD ² (%CP)	55.2 ^a	31.3 ^d	52.9 ^{ab}	46.9 ^c	48.3 ^{bc}	51.0 ^{abc}	35.2 ^d	2.43

¹Protein sources are SBM = soybean meal; ESBM = expeller soybean meal; ES = extruded soybeans; DDGS = distillers dried grains with solubles; NM = NovaMeal; HPDG = high-protein distillers dried grains; MWDGS = modified wet distillers grains with solubles.

^{a-e} Means within a row with different superscripts differ significantly ($P < 0.05$)

²RUPD = RUP digestibility (also called intestinally absorbable dietary protein); determined by method of Gargallo et al. (2006).

- Numerically, NovaMeal had the greatest amount of methionine present in the residue after a 16 hour incubation in the rumen and the lowest ruminal degradation of methionine (Table 2).
- Lysine content of the residue remaining after a 16 hour ruminal incubation was greatest for soybean sources vs. corn sources ($P < 0.05$).
- Intestinal digestibility of methionine did not differ by source (Table 2).
- Intestinal digestibility of lysine was greater for soybean sources vs. corn sources ($P < 0.05$; Table 2).
- The amount of methionine absorbed intestinally was greatest for NovaMeal and high protein distillers grains ($P < 0.05$; Table 2). Soybean meal had the lowest amount of methionine absorbed intestinally (Table 2).
- The amount of lysine absorbed intestinally did not differ between NovaMeal and soybean meal (Table 2).

Table 2. Ruminal degradability and intestinal digestibility of methionine and lysine in protein sources¹

	NM	SBM	ESBM	ES	DDGS	HPDG	MWDGS	SEM
Feed Composition (%CP)								
Methionine	19.9	14.3	14.2	14.8	20.4	20.4	19.0	
Lysine	32.2	64.7	60.5	67.0	34.8	29.5	34.3	
Residue Composition after 16 hour ruminal incubation (%CP)								
Methionine	22.9 ^a	15.1 ^c	16.2 ^c	16.7 ^{bc}	19.1 ^{abc}	21.9 ^{ab}	18.3 ^{abc}	0.99
Lysine	18.4 ^b	52.4 ^a	49.8 ^a	59.1 ^a	16.8 ^b	18.5 ^b	16.6 ^b	2.55
Ruminal degradation after 16 hour ruminal incubation (%)								
Methionine	37.2 ^c	81.9 ^a	48.2 ^{bc}	50.4 ^{bc}	55.4 ^{bc}	48.1 ^{bc}	63.8 ^{ab}	4.29
Lysine	68.7 ^{bcd}	85.8 ^a	62.9 ^{cd}	61.3 ^d	76.8 ^{abc}	69.7 ^{bcd}	81.8 ^{ab}	3.04
Intestinal digestibility (%)								
Methionine	94.8	93.8	97.0	96.1	95.0	94.2	93.7	1.18
Lysine	85.8 ^b	96.1 ^a	98.7 ^a	97.1 ^a	83.9 ^b	86.9 ^b	81.7 ^b	1.57
Estimated intestinally absorbed (%CP)								
Methionine	11.8 ^a	2.5 ^c	7.1 ^b	7.1 ^b	7.9 ^b	10.0 ^{ab}	6.4 ^b	0.84
Lysine	8.6 ^b	8.9 ^b	22.1 ^a	25.4 ^a	6.6 ^b	7.8 ^b	5.1 ^b	1.98

¹Protein sources are SBM = soybean meal; ESBM = expeller soybean meal; ES = extruded soybeans; DDGS = distillers dried grains with solubles; NM = NovaMeal; HPDG = high-protein distillers dried grains; MWDGS = modified wet distillers grains with solubles.

^{a-d} Means within a row with different superscripts differ significantly ($P < 0.05$)

SUMMARY

- NovaMeal had the greatest RUP and lowest RDP of the protein sources evaluated.
- NovaMeal had the greatest RUPD numerically, and had a greater RUPD than soybean meal, extruded soybeans, distillers grains and modified wet distillers grains.
- NovaMeal had the lowest ruminal degradation of methionine. Intestinal digestibility of methionine did not differ by source, suggesting greater intestinal absorption of methionine from NovaMeal.
- Lysine content of the residue remaining after a 16 hour ruminal incubation was greatest for soybean sources vs. corn sources. Intestinal digestibility of lysine was greater for soybean sources vs. corn sources. However, the amount of lysine absorbed intestinally did not differ between NovaMeal and soybean meal.
- These results suggest that methionine and lysine availability can be similar between soybean and corn sources, and one must look further than simply amino acid composition of the feedstuff when evaluating feeds for a diet.