

Performance and amino acid utilization of mid-lactation cows fed increasing amounts of NovaMeal

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A lactation study was conducted to evaluate the effects of feeding increasing amounts of NovaMeal (3.5% fat, 34.5% CP) at the expense of soybean products to mid-lactation dairy cows on milk production, milk composition, plasma metabolites and the mammary uptake of amino acids.

KEY STUDY RESULTS

- Milk fat increased as the level of NovaMeal in the diet increased ($P < 0.05$), while milk protein increased up to 20% inclusion of NovaMeal ($P < 0.05$; Table 1). Dry matter intake and milk yield were similar for all diets.
- Plasma methionine concentration increased as the level of NovaMeal in the diet increased ($P < 0.05$), and plasma lysine decreased as level of NovaMeal in the diet increased ($P < 0.05$).
- The mammary uptake of both methionine and lysine was similar for all diets, demonstrating that the high demand for metabolizable amino acids to synthesize milk and milk protein was not limited when NovaMeal was fed as the primary protein source, up to 30% inclusion.

MATERIALS & METHODS

Study length:

- 2 week covariate period
- 6 week experimental period

Diets formulation:

- Similar in nutrients (protein, energy, fiber)
- Contain 50:50, forage to concentrate ratio on a DM basis.
- Metabolizable protein balance was 427, 356, 400 and 229 g/d for 0, 10, 20 and 30% inclusion of NovaMeal, respectively.
- Lysine supply was 6.38, 6.04, 5.65 and 5.33 as %MP and methionine supply was 1.72, 1.73, 1.73 and 1.75 as %MP for 0, 10, 20 and 30% inclusion of NovaMeal, respectively. These values were all below the breakpoints of 6.8% Lysine as %MP and 2.4% Methionine as %MP that are published in NRC (2001).
- NE_L balance was 2.7, 1.8, 3.1, and -0.6 Mcal for 0, 10, 20 and 30% inclusion of NovaMeal, respectively.

Assumptions made to determine mammary uptake of amino acids:

- Mammary plasma flow = $[(\text{milk Phe} + \text{Tyr}) \times 0.965 / (\text{arterio-venous (AV) difference of (Phe} + \text{Tyr)})]$, where estimates of milk Phe = 4.9g/100 g milk and milk Tyr = 5.1g/100 g milk
- Extraction efficiency = $\text{AV difference} / \text{arterial concentration} \times 100$
- Mammary uptake = $\text{AV difference} \times \text{mammary plasma flow}$

TRIAL DESIGN

- Cows were randomly assigned to one of 4 treatments based on day in milk and parity (41 cows; 22 multiparous, 19 primiparous)
 - Control – Soybean meal (SBM) and expellers soybean meal (ESBM) were the protein sources fed.
 - 10% dietary inclusion of NovaMeal – NovaMeal replaced 1/3 of SBM and ESBM fed in the Control diet.
 - 20% dietary inclusion of NovaMeal – NovaMeal replaced 2/3 of SBM and ESBM fed in the Control diet.
 - 30% dietary inclusion of NovaMeal – NovaMeal was the protein source fed.
- DIM was 176 for multiparous cows and 188 for primiparous cows at the beginning of the covariate period.
- Cow was the experimental unit.

STATISTICS

- Data were analyzed using the MIXED procedure of SAS.
- Week was the repeated measure.
- Covariate values were used for all repeated measurements.
- Plasma measurements, BW and BCS were evaluated at a single time point. Thus, time was not evaluated.



NOVAMEAL

STUDY RESULTS

- Dry matter intake and milk yield were similar for all diets (Table 1).
- Milk fat percentage and yield increased linearly as the level of NovaMeal in the diet increased. ($P < 0.05$; Table 1).
- Milk protein percentage increased quadratically, and was greatest when NovaMeal inclusion was 20% ($P < 0.05$; Table 1).
- Milk protein yield tended to increase quadratically, and was greatest when NovaMeal inclusion was 20% ($P < 0.05$; Table 1).
- Milk urea nitrogen decreased linearly as the level of NovaMeal in the diet increased. ($P < 0.05$; Table 1).

Table 1. Production data of cows fed 0, 10, 20 or 30% inclusion of NovaMeal

	Treatment, % inclusion of NovaMeal				SEM
	0	10	20	30	
DM Intake (lb/d)	49.9	50.6	52.1	48.8	1.72
Milk Yield (lb/d)	75.9	76.6	78.1	77.4	1.36
Milk Fat (%) ^a	3.18	3.4	3.46	3.72	0.18
Milk Fat Yield (lb/d) ^a	2.38	2.62	2.71	2.90	0.18
Milk Protein (%) ^b	2.99	3.06	3.13	2.99	0.04
Milk Protein Yield (lb/d) ^c	2.27	2.35	2.42	2.33	0.04
MUN (mg/dL) ^a	15.84	14.62	13.68	13.03	0.42

^a Linear effect, $P < 0.05$.
^b Quadratic effect, $P < 0.05$.
^c Quadratic effect, $P < 0.15$.

- Plasma methionine concentration increased and plasma lysine concentration decreased with increasing inclusion of NovaMeal ($P < 0.05$; Table 2).
- The arterio-venous difference for methionine was similar for all treatments. The arterio-venous difference for lysine decreased with increasing inclusion of NovaMeal ($P < 0.05$; Table 2).
- Mammary uptake was similar for methionine and lysine was similar amongst treatments (Table 2).
- Extraction efficiency for methionine decreased with increasing inclusion of NovaMeal ($P < 0.05$; Table 2). Extraction efficiency for lysine increased with increasing inclusion of NovaMeal ($P < 0.05$; Table 2).
- Thus, high demand for metabolizable amino acids to synthesize milk and milk protein was not limited when NovaMeal was fed as the primary protein source, up to 30% inclusion. This was demonstrated by the similar mammary uptake for lysine and methionine by cows fed NovaMeal.

Table 2. Measures of amino acid utilization for methionine and lysine for cows fed 0, 10, 20 or 30% inclusion of NovaMeal

	Treatment, % inclusion of NovaMeal				SEM
	0	10	20	30	
Arterial Plasma Concentration (uM/L)					
Methionine ^{ab}	16.5	17.9	22.5	29.3	1.6
Lysine ^a	66.0	57.6	51.9	44.7	3.3
Arterio-venous Difference (uM/L)					
Methionine	12.1	10.4	11.8	12.4	1.6
Lysine ^a	42.6	37.1	36.5	32.4	2.9
Extraction Efficiency ¹ (%)					
Methionine ^a	71.6	57.5	50.8	42.7	5.6
Lysine ^a	64.3	64.4	70.6	72.1	2.3
Mammary uptake ² (g/kg of milk)					
Methionine	0.82	0.76	0.90	0.99	0.18
Lysine	2.88	2.60	2.63	2.69	0.30

¹Extraction efficiency = arterio-venous difference/ arterial concentration x 100.
²Mammary uptake = arterio-venous difference x mammary plasma flow.
^a Linear effect, $P < 0.05$.
^b Quadratic effect, $P < 0.15$.

SUMMARY

- Milk fat increased as the level of NovaMeal in the diet increased, while milk protein increased up to 20% inclusion of NovaMeal. Dry matter intake and milk yield were similar for all diets.
- Plasma methionine concentration increased as the level of NovaMeal in the diet increased, and plasma lysine decreased as level of NovaMeal in the diet increased.
- The high demand for metabolizable amino acids to synthesize milk and milk protein was not limited when NovaMeal was fed as the primary protein source, up to 30% inclusion. This was demonstrated by similar uptake of both methionine and lysine by the mammary gland. Additionally, milk protein increased up to 20% inclusion of NovaMeal.