TOTAL AMINO ACID CONTENT VARIATION FOR COMMERCIAL TMR AND RELATIONSHIP TO CRUDE PROTEIN

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS

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INTRODUCTION:

- Dairy cattle amino acid (AA) nutrition has evolved with NRC (2001), CPM, CNCPS (Van Amburgh et al., 2015) and NorFor (Volden et al., 2011) model improvements
  - Current models rely on total amino acid (TAA) estimates within rumen undegraded protein predictions to estimate AA supply to the animal
  - For example, NRC (2001) assumes a linear relationship between rumen undegradable protein (RUP) and TAA content
- Ingredients rich in AA, including rumen protected AA, are added in precise amounts to dairy diets, based upon TAA supply, with the aim to more precisely balance AA supply and better meet nutrient needs
- However, animal health and performance still vary relative to expected responses in many cases when balancing for AA
  - Performance still lags behind monogastric nutrition partly because of AA metabolism and microbial interactions in the rumen
  - Performance may also lag due to model inaccuracies in predicted TAA supply

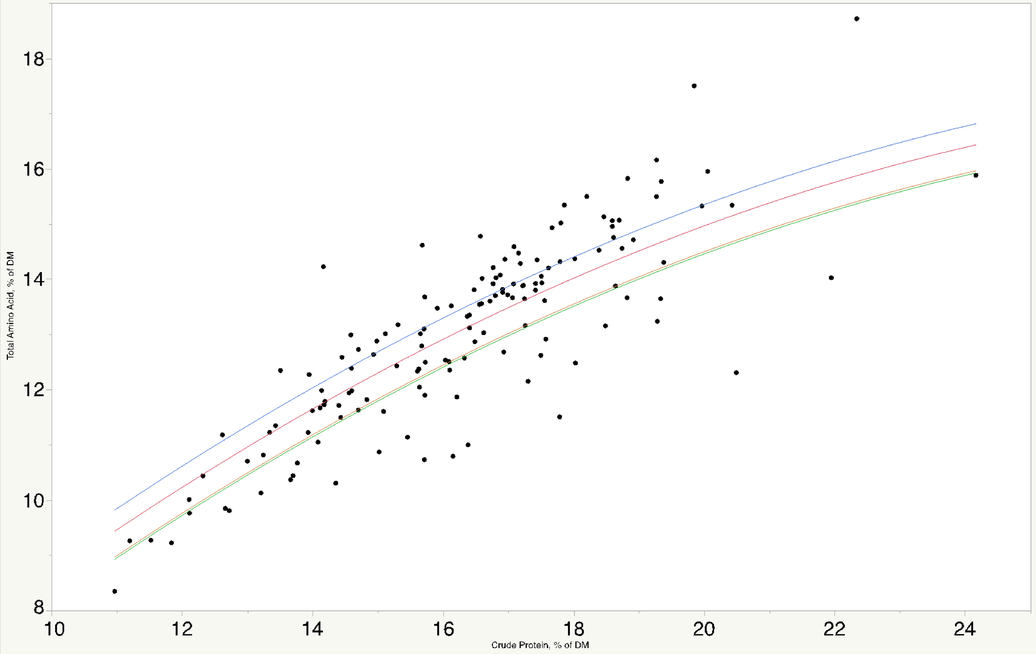
OBJECTIVE:

The objective of this project was to describe total AA population statistics and to determine if TAA varied linearly relative to crude protein (CP), for commercial dairy and beef total mixed rations, as is assumed in models.

Table 1: Population statistics for dairy and beef TMR CP and TAA (% of DM)

TYPE	PARAMETER	n	MEAN	ST.DEV.	MIN.	MAX.
Beef	CP	9	13.2	1.2	11.2	14.7
Beef	TAA	9	11.1	1.1	9.3	12.7
Dry	CP	47	15.3	1.9	11.5	19.4
Dry	TAA	47	11.9	1.4	9.2	15.8
Lactating	CP	76	17.3	1.6	13.7	22.3
Lactating	TAA	76	14.0	1.2	10.4	18.7

Figure 1: Final model fit for CP (% of DM) in relation to TAA content, % of DM, for commercial dairy and beef TMR samples.



MATERIALS AND METHODS:

- Commercial total mixed rations, n=141, were selected from samples submitted to Rock River Laboratory (Watertown, WI) for further CP and TAA analyses.
  - Samples submitted as dry, lactating dairy, finishing beef and unknown TMR were identified by the description provided
  - Samples were dried using a sequential microwave and 3h 105 degree C forced air oven technique then ground to pass a 1 mm screen (Udy Cyclone Mill, UDY Corp. Fort Collins, CO)
- TMR CP was determined as total nitrogen content x 6.25 after assaying N by a combustion technique
- TAA were determined after acid-hydrolysis using o-phtaldialdehyde colorimetry and fluorimetry adapted to flow-injection analysis (Colombini et al., 2011)
- The TMR type (beef, lactating, dry, and unknown) and CP were related to TAA using Fit Model function within JMPv11.0 (SAS, CARY, NC)
  - TMR type was considered random
  - Interactions and quadratic effects were tested
  - Residuals were visually assessed for normality using a residual by predicted plot
    - The sample population was assumed to be normal

RESULTS AND DISCUSSION:

- Commercial TMR CP and TAA (% of DM) population statistics for samples, except those described as unknown, are described in Table 1
  - The lactating dairy cow TMR sample population exhibited numerically greater CP than dry cow TMR, and dry cow greater than beef cattle TMR, which is logical albeit sample numbers were limited for beef cattle TMR
- Both linear and quadratic relationships between CP and TAA were detected ($P<0.05$)
- The final model exhibited an adjusted $R^2 = 0.78$ and a root mean square error of 0.83
  - The model parameter estimates (and standard error (SE)) are as follows: 3.48 + CP x 0.58 (SE 0.04) + CP^2 x -0.02 (SE 0.01)
- The quadratic effect was unanticipated and suggests a nonlinear relationship between TAA and CP
  - The final model by feed type can be visualized in Figure 1
- The linear slope estimate less than 1.0, for TAA relative to CP, may be partly due to non-AA N in the form of urea, NH3-N or amide N present as glutamine and asparagine
  - All of these compounds contribute N to CP but not to TAA equivalence

CONCLUSIONS:

- Results presented here demonstrate variation in TAA content for commercial dairy and beef TMRs
- These commercial farm TMR results, and the observed non-linear relationship between CP and TAA, may be useful when considering future nutrition model development and validation parameters
- Further, knowing TMR TAA in addition to CP may help improve on farm nutrition and troubleshooting
  - Understanding TMR TAA relative to CP may help identify and separate unknown non-amino acid N from CP
  - Some unknown non-AA N could be formed by forage proteolysis during ensiling, among other processes

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