PARTITIONING VARIANCE IN NUTRIENT CONCENTRATIONS OF DRY COW TOTAL MIXED RATIONS

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS

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INTRODUCTION:

- Many sources contribute variation to laboratory total mixed ration (TMR) nutrient measures, however it is unknown which sources contribute the most variation.
- TMR in particular is considered to be a difficult matrix to sample due to its heterogeneous nature.
- TMR sampling and analysis offers a means to determine if a precise and accurate ration has been delivered to all animals on the farm.
  - Dairy cattle thrive upon consistent nutrient supply, permitting animals to achieve their genetic potential.
- Consistent nutrient supply is especially important for cows in the transition period, as we look to minimize the stress and amount of changes they are exposed to during this sensitive time.
- The variation attributed to on-farm sampling and laboratory sampling can make it difficult to understand nutritional opportunities in rations.

OBJECTIVE:

- The objective of this study was to determine if variation sources for major nutrient measures in a dry cow total mixed ration sampling program were greater at the farm or in the laboratory, for commercial dairy herds.

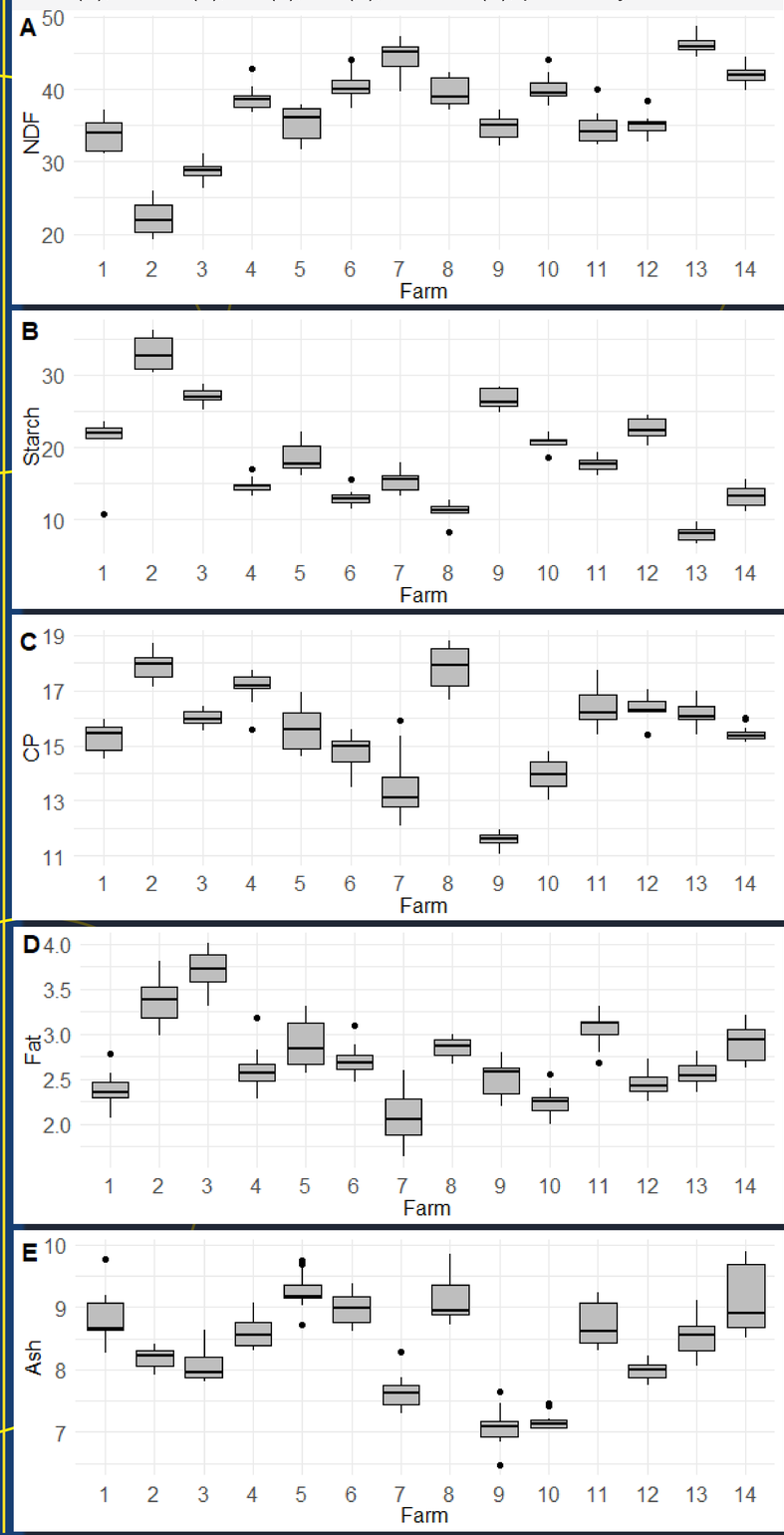
Table 1. Average within-farm variation in nutrient concentrations for the dry cow TMR samples.

	NDF	Starch	CP	Fat	Ash
SD	0.58	1.42	1.57	0.17	0.23
CV	3.31	6.29	3.47	5.26	2.25

Table 2. Variance(%) attributed to on-farm sampling and lab sub-sampling for nutrient measures with dry cow TMR samples.

	Total % of Variance		
Nutrient % of DM	Farm Sampling	Lab Sub-sampling	Residual
NDF	17.65	1.28	81.07
Starch	31.83	0.71	67.46
CP	14.91	3.29	81.80
Fat	12.06	1.16	86.78
Ash	13.22	2.12	84.66
Nutrient Average	17.93	1.71	80.35

Figure 1. Distribution of Nutrient Concentrations, % of DM, for NDF(a), Starch(b), CP(c), Fat(d), and Ash(e), plotted by farm.



MATERIALS AND METHODS:

- Samples were collected and submitted to a commercial laboratory* from 14 commercial dairy farms across the US
  - The entire sampling process was repeated twice by each individual to replicate on-farm sampling
- At the laboratory, technicians divided each sample into 2 subsamples using a mixing and quartering technique
- Subsamples were microwave-oven dried and ground to pass a 1 mm screen
- Ground samples were then divided into three subsamples and analyzed using Near Infrared spectroscopy (NIR) (n=167)
- Total variance was partitioned between farm, farm-level sampling, and lab-level sampling
- Data were analyzed using a mixed model in SAS JMP Pro v15.0
- Farm sampling was included in all models as a fixed effect, while farm-level and lab-level sampling were random effects
- Relative variance attributed to on-farm sampling and lab sub-sampling for each nutrient was determined using covariance parameter estimates

RESULTS:

- The fixed effect of farm was significant for each nutrient analyzed ($P < 0.0001$)
  - This is logical, understanding that each farm will have different goals and diets
- The relative variance percentage associated with lab sub-sampling was less than 4% for all nutrients analyzed, and 1.7% on average
  - Percentage of lab variance was largest for CP (3.29%) and smallest for starch (0.71%)
- The variance associated with on-farm sampling was far greater than that of lab sampling for all nutrients
  - On-farm variance was largest for starch (31.83%) and smallest for fat (12.06%)
- Average within-farm CV ranged from 2.25% to 6.29% and was the largest for starch
- On average, the on-farm sampling contributed 10.5 times greater variance relative to the laboratory sub-sampling

CONCLUSION:

- On-farm sampling contributes far more variance to results than does laboratory technician sub-sampling
- On-farm sampling programs should consider additional replicates or alternative strategies to account for this sizable amount of variance
  - This study highlights the impact sampling techniques on-farm will have upon results and subsequent interpretation
- The wide range in nutrient concentrations also showcases the many different approaches to dry cow ration formulation