Partitioning variation in mineral concentrations of dry cow total mixed rations on commercial dairy farms.

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Abstract #P394

BACKGROUND

- Proper dry cow nutrition is essential for a smooth transition period and a productive lactation.
- Variability in measured mineral concentrations of the dry cow ration can pose a risk to the accuracy of ration formulation.
- Identifying sources of variation in mineral concentrations of dry cow rations could lead to strategies capable of improving the management of the dry cow nutrition program on a farm.

OBJECTIVES

- The objective of this experiment was to quantify selected sources of variation in mineral concentrations of dry cow total mixed ration (TMR) samples from commercial dairy farms.

MATERIALS & METHODS

- Duplicate TMR samples collected by dairy consultants from 14 farms in the US were sent to a commercial laboratory
- Technicians divided each sample into 2 subsamples using a mixing and quartering technique.
- Each subsample was then microwave oven-dried and ground to pass through a 1.0 mm screen.
- These samples were then divided into 3 subsamples, each of which (n = 167) were analyzed for nutrients using NIRS and macro- and micro-minerals using inductively coupled plasma-optical emission spectrometry.
- Total variance was partitioned into that associated with sampling at the farm, with the first subsampling at the laboratory, and with the second laboratory subsampling and subsequent analysis.
- Data were analyzed using PROC GLIMMIX in SAS. The model included farm as a fixed effect and farm sampling, first subsampling (within farm sampling), and second subsampling (within first subsampling) as random effects.
- Covariance estimates, compared on a relative basis for each mineral, were used to compare variance attributed to on-farm sampling versus subsampling at the laboratory

RESULTS

Table 1. Descriptive statistics for nutrient composition of dry cow total mixed rations collected from 14 commercial dairy farms.

	n	Average	SD	Minimum	Maximum	CV, %
DM, % as-fed	56	54.1	9.1	36.6	72.1	16.8
CP, % DM	167	15.6	1.8	11.0	18.8	11.3
NDF, % DM	167	36.8	6.3	19.2	48.7	17.1
Starch, % DM	167	18.8	6.9	6.7	36.2	36.7
Fat, % DM	167	2.8	0.6	1.6	8.3	22.9
Ash, % DM	167	8.3	1.0	0.5	9.9	11.6

Table 2. Descriptive statistics for mineral concentrations of dry cow total mixed rations collected from 14 commercial dairy farms.

	n	Average	SD	Minimum	Maximum	CV, %
Ca, % DM	167	1.2	0.2	0.6	1.9	19.3
K, % DM	167	1.1	0.2	0.7	1.4	13.7
Mg, % DM	167	0.4	0.1	0.2	0.6	26.4
Na, % DM	167	0.2	0.1	0.1	0.3	46.6
P, % DM	167	0.3	0.1	0.2	0.5	18.1
S, % DM	167	0.3	0.1	0.2	0.5	26.3
Cu, mg/kg	167	17.5	7.8	11.0	46.4	44.6
Fe, mg/kg	167	459.4	173.3	221.2	1053.0	37.7
Mn, mg/kg	167	84.5	22.1	39.5	136.0	26.1
Zn, mg/kg	167	81.5	27.8	30.8	143.5	34.1

Table 3. Comparison of variance in mineral concentrations of dry cow total mixed rations attributed to on-farm sampling versus subsampling at the laboratory.

	% of Total Variance		
Item	Farm Sampling	Lab Subsampling	Residual
Ca	55.7	0.9	43.4
K	40.9	1.5	57.6
Mg	23.3	0.7	76.1
Na	2.2	1.2	96.7
P	21.6	2.7	75.7
S	9.1	3.1	87.8
Cu	10.4	0.0	89.6
Fe	39.1	0.4	60.5
Mn	12.1	5.6	82.3
Zn	8.6	0.8	90.6
Macro-mineral average	25.4	1.7	72.9
Trace-mineral average	17.6	1.7	80.7

Table 4. Average within-farm variation in mineral concentrations of dry cow total mixed rations.

	Ca % DM	K % DM	Mg % DM	Na % DM	P % DM	S % DM	Cu mg/kg	Fe mg/kg	Mn mg/kg	Zn mg/kg
SD	0.12	0.04	0.02	0.01	0.02	0.03	1.14	40.36	4.34	4.02
CV, %	9.5	3.7	4.4	4.6	5.9	9.3	6.2	9.1	5.4	4.9

SUMMARY

- Across all 14 farms, concentrations of DM, CP, NDF, and starch averaged 54.1, 15.6, 36.8, and 18.8% of DM, respectively (Table 1).
- Variation in nutrient composition was greatest for starch (CV = 36.7%) and lowest for CP (CV = 11.3%; Table 1).
- Variation in mineral concentrations was greatest for Na (CV = 46.6%) and lowest for K (CV = 13.7%; Table 2).
- Concentrations of Ca averaged 1.2 ± 0.2% (mean ± SD) of DM, ranging from 0.6 to 1.9% of DM (CV = 19.3%; Table 2).
- Concentrations of K averaged 1.1 ± 0.2% of DM, ranging from 0.7 to 1.4% of DM (CV = 13.7%; Table 2).
- More than 25% of the variance in macro-mineral concentrations could be attributed to farm sampling, compared to 1.7% attributed to the first laboratory subsampling (Table 3).
- More than 17% of the variance in trace-mineral concentrations could be attributed to farm sampling, compared to 1.7% attributed to the first laboratory subsampling.
- Coefficients of variation for dietary mineral concentrations within a farm ranged from 3.7% to 9.5% (Table 4)

CONCLUSIONS

- Results indicate that the majority of the variation in the TMR can be attributed to sampling at the farm level
- Careful collection of representative TMR samples can aid in the reduction of variation in measured mineral concentrations and should be a key component of any successful dry cow nutrition program.