

### 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 o 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

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

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	n	Average	SD	Minimum	Maximum	CV, %
DM, % as-fe		54.1	9.1	36.6	72.1	16.8
CP, % DM	u 00 167	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		18.8	6.9	6.7	36.2	36.7
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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
<b>Table 2.</b> Descriptive st	tatistics for min	eral concentrations				
	<u>n</u>	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	170 0	221.2	1053.0	37.7
			173.3		1055.0	57.7
Mn, mg/kg	167	84.5	22.1	39.5	136.0	26.1
Zn, mg/kg <b>Table 3.</b> Comparison o	167 of variance in r	84.5 81.5	22.1 27.8	39.5 30.8	136.0 143.5	26.1 34.1
Zn, mg/kg <b>Fable 3.</b> Comparison of Subsampling at the lab	167 of variance in r ooratory.	84.5 81.5	22.1 27.8 ons of dry cov	39.5 30.8 v total mixed ratio	136.0 143.5 ons attributed to	26.1 34.1
Zn, mg/kg <b>Table 3.</b> Comparison of Subsampling at the lab	167 of variance in r ooratory.	84.5 81.5	22.1 27.8 ons of dry cov	39.5 30.8 v total mixed ratio	136.0 143.5 ons attributed to <b>ng Residua</b>	26.1 34.1
Zn, mg/kg <b>Table 3.</b> Comparison of subsampling at the lab	167 of variance in r ooratory.	84.5 81.5 nineral concentration	22.1 27.8 ons of dry cov % c Sampling 55.7	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4	26.1 34.1
Zn, mg/kg	of variance in r ooratory. Item Ca K	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin	136.0 143.5 ons attributed to <b>Residua</b> 43.4 57.6	26.1 34.1
Zn, mg/kg	of variance in r boratory. Item Ca K Mg	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4	26.1 34.1
Zn, mg/kg	of variance in r boratory. Item Ca K Mg Na	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2	136.0 143.5 ons attributed to <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	26.1 34.1
Zn, mg/kg	of variance in r boratory. Item Ca K Mg Na P	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7	136.0 143.5 ons attributed to <b>96.7</b> 75.7	26.1 34.1
Zn, mg/kg	of variance in r oratory. <b>Item</b> Ca K Mg Na P S	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2	136.0 143.5 ons attributed to <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	26.1 34.1
Zn, mg/kg	of variance in r ooratory. Item Ca K Mg Na P S Cu	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7	136.0 143.5 ons attributed to <b>96.7</b> 75.7	26.1 34.1
Zn, mg/kg	167 of variance in r boratory. <b>Item</b> Ca K Mg Na P S Cu Fe	84.5 81.5 nineral concentration Farm \$	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1	136.0 143.5 ons attributed to <b>143.4</b> 43.4 57.6 76.1 96.7 75.7 87.8	26.1 34.1
Zn, mg/kg	of variance in r ooratory. Item Ca K Mg Na P S Cu	84.5 81.5 nineral concentration Farm \$	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0	136.0 143.5 ons attributed to <b>1</b> <b>Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6	26.1 34.1
Zn, mg/kg	167 of variance in r boratory. <b>Item</b> Ca K Mg Na P S Cu Fe	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4	136.0 143.5 ons attributed to <b>1</b> <b>Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5	26.1 34.1
Zn, mg/kg	of variance in r ooratory. Item Ca K Mg Na P S Cu Fe Mn	84.5 81.5 nineral concentration Farm 3	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 12.1	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3	26.1 34.1
Zn, mg/kg	of variance in r boratory. Item Ca K Mg Na P S Cu Fe Mn Zn	84.5 81.5 nineral concentration Farm	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 10.4 39.1 12.1 8.6	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6 0.8	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3 90.6	26.1 34.1
Zn, mg/kg	of variance in r boratory. Item Ca K Mg Na P S Cu Fe Mn Zn Macro-mineral Trace-mineral	84.5 81.5 nineral concentration	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 10.4 39.1 12.1 8.6 25.4 17.6	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6 0.8 1.7 1.7	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3 90.6 72.9 80.7	26.1 34.1
Zn, mg/kg <b>Table 3.</b> Comparison of subsampling at the lat <b>Table 4.</b> Average with Ca	167 of variance in r boratory. Item Ca K Mg Na P S Cu Fe Mn Zn Cu Fe Mn Zn Macro-mineral Trace-mineral	84.5         81.5         nineral concentration         Farm         Farm         average         <	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 10.4 39.1 12.1 8.6 25.4 17.6 ntrations of d <b>P</b>	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6 0.8 1.7 1.7 vy cow total mixed	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3 90.6 72.9 80.7 d rations. <b>Fe</b>	26.1 34.1
Zn, mg/kg <b>Table 3.</b> Comparison of Subsampling at the lab <b>Table 4.</b> Average with Ca % D	167 of variance in r boratory. Item Ca K Mg Na P S Cu Fe Mn Zn Macro-mineral Trace-mineral	84.5         81.5         nineral concentration         Farm         Farm         average         average         average         on in mineral conce         Mg       Na         % DM       % DM	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 12.1 8.6 25.4 17.6 ntrations of d <b>P</b> M	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6 0.8 1.7 1.7 1.7 ry cow total mixed S Cu mg/kg	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3 90.6 72.9 80.7 d rations. <b>Fe</b> mg/kg	26.1 34.1 o on-farm sa
Zn, mg/kg Table 3. Comparison of subsampling at the lab Table 4. Average with Ca	167         of variance in resoratory.         Item         Ca         K         Mg         Na         P         S         Cu         Fe         Mn         Zn         Macro-mineral         Trace-mineral         in-farm variation         M         2       0.04	84.5         81.5         nineral concentration         Farm         Farm         average         <	22.1 27.8 ons of dry cov % c Sampling 55.7 40.9 23.3 2.2 21.6 9.1 10.4 39.1 10.4 39.1 12.1 8.6 25.4 17.6 ntrations of d <b>P</b>	39.5 30.8 v total mixed ratio of Total Variance Lab Subsamplin 0.9 1.5 0.7 1.2 2.7 3.1 0.0 0.4 5.6 0.8 1.7 1.7 vy cow total mixed	136.0 143.5 ons attributed to <b>ng Residua</b> 43.4 57.6 76.1 96.7 75.7 87.8 89.6 60.5 82.3 90.6 72.9 80.7 d rations. <b>Fe</b>	26.1 34.1

## **RFSUITS**

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SD	Minimum	Maximum	CV, %
9.1	36.6	72.1	16.8
1.8	11.0	18.8	11.3
6.3	19.2	48.7	17.1
6.9	6.7	36.2	36.7
0.6	1.6	8.3	22.9
1.0	0.5	9.9	11.6

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## Abstract #P394

	SUMMARY
ms.	<ul> <li>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).</li> </ul>
	<ul> <li>Variation in nutrient composition was greatest for starch (CV = 36.7%) and lowest for CP (CV = 11.3%; Table 1).</li> </ul>
farms.	<ul> <li>Variation in mineral concentrations was greatest for Na (CV = 46.6%) and lowest for K (CV = 13.7%; Table 2).</li> </ul>
	<ul> <li>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).</li> </ul>
	<ul> <li>Concentrations of K averaged 1.1 ± 0.2% of DM, ranging from 0.7 to 1.4% of DM (CV = 13.7%; Table 2).</li> </ul>
rsus	<ul> <li>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).</li> </ul>
	<ul> <li>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.</li> </ul>
	<ul> <li>Coefficients of variation for dietary mineral concentrations within a farm ranged from 3.7% to 9.5% (Table 4)</li> </ul>
	CONCLUSIONS
	<ul> <li>Results indicate that the majority of the variation in the TMR can be attributed to sampling at the farm level</li> </ul>
	<ul> <li>Careful collection of representative TMR samples can aid in the reduction of variation in measured mineral concentrations and should be a key</li> </ul>

component of any successful dry cow nutrition program.