

INTRODUCTION

- Undigested neutral detergent fiber residue on an organic matter basis (**uNDFom**) is related to gut fill limits, dry matter intake (**DMI**), and potential milk production
- Gold standard method is in vitro fermentation for 30, 120, and 240 h of digestion
 - Some commercial labs have near-infrared (**NIR**) analysis of uNDFom and NDF on an organic matter basis (**aNDFom**)
- Dry forages imported from the US and fed in Japan currently are only graded visually
- Assessment of the dry forages for uNDFom will improve nutritional evaluation and ration formulation

OBJECTIVES

- Measure uNDFom composition of dry forages typically fed in Japan
- Assess accuracy of NIR analysis for uNDFom of dry forages
- Model effect of uNDFom differences on prediction of DMI and milk production

MATERIALS AND METHODS

- Thirteen dry forages with different grades or processing were obtained from Washington and Oregon state

- | | |
|-----------------------------------------------|--------------------------------------------|
| ◆ Alfalfa Premium | ◆ Sudan grass Fine/Standard (F/S), pressed |
| ◆ Alfalfa #1 | ◆ Sudan grass F/S, not pressed |
| ◆ Timothy 1 st cut Premium | ◆ Klein grass #1, pressed |
| ◆ Timothy 1 st cut #1 | ◆ Klein grass #1, not pressed |
| ◆ Timothy 2 nd cut #1 | ◆ Ryegrass straw |
| ◆ Sudan grass Premium/Standard (P/S), pressed | ◆ Fescue straw |
| ◆ Sudan grass P/S, not pressed | |

- Forages were graded based on crude protein (Alfalfa), thickness of stems and color (Sudan), or color and bleach (Timothy and Klein)
- Forages were ground to pass a 1-mm screen and sent to 3 commercial labs in the US (**Lab A, B, and C**) to conduct wet chemistry and NIR analysis for aNDFom and uNDFom
- Wet chemistry results for all labs were averaged for each analyte to create reference values (**Ref**)



- Mean difference between Ref and NIR results, and standard deviation of the differences were plotted
 - NIR similarity to wet chemistry was described as the Euclidean distance from the center point (**ED**) for ranking the performance of labs
- Rations including the forages were formulated using the Cornell Net Carbohydrate and Protein System (**CNCPS v. 6.55**) in NDS (v. 3.9 RUM&N Sas, Reggio Emilia, Italy)

RESULTS

Table 1. Wet chemistry results (% of dry matter)

Forages	aNDFom		uNDFom30		uNDFom120		uNDFom240	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Alfalfa Premium	43.5	0.6	25.2	0.3	24.0	0.5	23.1	0.7
Alfalfa #1	44.8	0.5	26.3	0.5	25.4	0.3	24.6	0.4
Timothy 1 st Premium	59.8	0.5	29.5	0.2	23.5	2.0	21.3	1.2
Timothy 1 st #1	58.5	0.7	27.7	0.5	20.9	1.2	19.2	1.1
Timothy 2 nd #1	61.0	0.7	33.7	0.8	24.9	1.0	22.7	1.2
Sudan P/S, pressed	61.4	0.4	21.4	0.4	13.8	0.9	11.5	1.0
Sudan P/S, not pressed	61.4	0.7	22.4	0.6	14.2	1.1	12.3	1.1
Sudan F/S, pressed	67.6	0.5	29.7	0.7	17.4	0.4	15.5	0.9
Sudan F/S, not pressed	67.9	0.7	29.8	0.7	18.6	0.4	16.7	0.4
Klein #1, pressed	64.8	1.1	27.0	0.9	21.9	0.2	20.5	0.5
Klein #1, not pressed	66.4	0.9	27.7	1.4	19.1	0.3	17.9	0.4
Ryegrass straw	72.6	0.9	44.8	1.9	31.4	0.5	29.4	0.3
Fescue straw	70.0	1.0	43.1	1.1	31.4	0.5	30.6	1.0

Table 2. NIR results of each laboratory (% of dry matter)

Forages	aNDFom			uNDFom30			uNDFom120			uNDFom240		
	A	B	C	A	B	C	A	B	C	A	B	C
Alfalfa Premium	43.1	41.3	40.3	24.1	25.0	25.2	21.7	19.3	19.4	20.9	17.9	18.2
Alfalfa #1	45.8	45.2	46.3	26.9	27.8	27.0	25.7	23.1	26.8	24.4	21.2	25.7
Timothy 1 st Premium	57.8	60.1	55.5	28.6	28.8	29.7	19.4	19.3	20.8	17.4	17.7	19.0
Timothy 1 st #1	57.2	60.0	54.3	27.1	28.3	28.2	15.1	19.6	18.2	14.3	18.3	16.4
Timothy 2 nd #1	60.9	61.5	56.5	34.4	32.9	33.7	21.9	25.2	21.7	19.1	23.4	20.0
Sudan P/S, pressed	62.3	67.9	59.6	25.0	28.5	20.9	15.7	18.9	13.4	12.1	17.1	11.0
Sudan P/S, not pressed	62.3	69.1	60.8	25.0	30.0	21.6	16.0	20.6	14.7	12.4	17.9	12.3
Sudan F/S, pressed	67.0	71.9	66.1	32.3	35.9	29.9	19.9	25.7	22.4	16.3	22.5	20.1
Sudan F/S, not pressed	67.0	72.5	67.5	32.0	37.0	28.6	20.6	26.2	23.3	17.6	23.0	21.0
Klein #1, pressed	62.8	62.5	57.8	26.0	29.0	28.4	21.3	19.1	18.7	19.9	16.4	16.6
Klein #1, not pressed	63.5	63.5	59.6	26.3	28.7	29.5	18.0	18.4	16.4	16.4	16.2	14.1
Ryegrass straw	71.0	73.5	71.9	41.6	41.6	47.7	26.9	29.8	33.0	26.1	27.4	30.9
Fescue straw	68.9	71.2	69.4	41.1	41.2	44.6	28.9	29.3	32.9	26.6	26.9	31.0

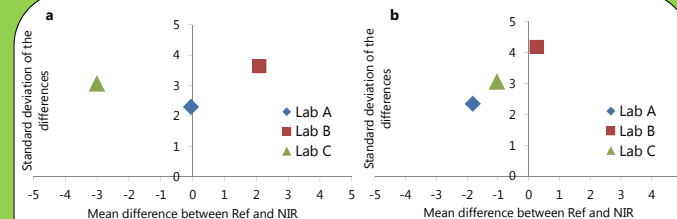


Figure 1. Euclidean distance plots (a: uNDFom30, b: uNDFom240)

Table 3. NIR similarity to wet chemistry described as the Euclidean distance

	Lab A	Lab B	Lab C
aNDFom	1.80	4.11	4.29
uNDFom30	2.30	4.20	4.29
uNDFom120	3.14	4.35	3.66
uNDFom240	2.97	4.19	3.69

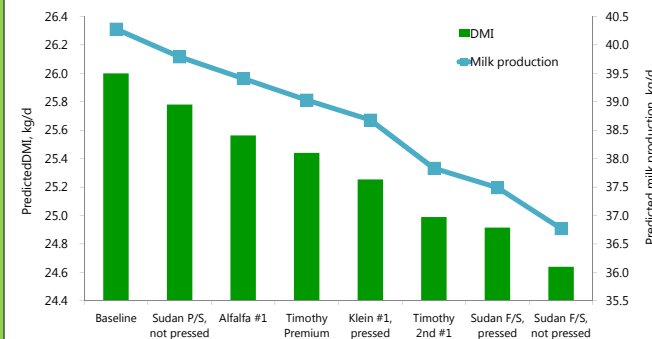


Figure 2. Predicted dry matter intake and milk production based on wet chemistry results. Each ration included 14 kg/d of concentrate mix and 12 kg/d of dry forages (Baseline: 3 kg of Alfalfa Premium, 3 kg of Timothy 1st #1, 3 kg of Sudan P/S, pressed and 3 kg of Klein #1, not pressed. Others: one of the Baseline forages was replaced with another grade or processing)

SUMMARY

- The uNDFom composition differed with forage type
 - Visual grading did not predict uNDFom profile
- The NIR accuracy for uNDFom described as ED ranged from 2.30 to 3.14 at Lab A, from 4.19 to 4.35 at Lab B, and from 3.66 to 4.29 at Lab C
 - The Lab A appeared to have the smallest differences between wet chemistry and NIR across the range of dry forages
- Predicted DMI and milk production varied as a function of forage uNDFom content

CONCLUSIONS

- To improve on simple visual grading of dry forages, use of uNDFom analyzed by wet chemistry or NIR provides a measure of nutritional value that is related to DMI and milk yield.