Focus on Forage

Wisconsin TEAM Forage

Nutrient Composition of Straw Used in Dairy Cattle Diets

by ***Tom Anderson and Patrick Hoffman***

Introduction

Small-grain straw has become popular in dairy cattle diets. There are three principle reasons for including straw in diets fed to dry and lactating dairy cows or dairy heifers:

1. To reduce the nutrient (primarily energy) density of the diet. For dairy heifer diets straw is commonly added to the diet to dilute energy content to prevent over-conditioning. The same strategy is used with dry or pre-fresh dairy cows to avoid over conditioning. Low inclusion rates of straw are also often used in lactating dairy cow diets to assure fiber adequacy and stimulate rumination as an aid to preventing acidosis and milkfat test depression.
2. To "dry-out" wet diets. Straw can be added to diets formulated with wet ingredients to increase the dry matter content of the diet and make the ration more acceptable to dairy cattle.
3. To alter the dietary cation to anion ratio in dry cow diets. Straws are often low in potassium and inclusion of low potassium forages can aid in the prevention of milk fever in transition dairy cows.

What is the nutritive value of straw?

Straws are typically high in fiber and low in crude protein and energy making them an excellent forage in situations where dietary energy or protein dilution is desired. Typical nutrient compositions of straw fed to dairy cattle are presented in the Table and represent commonly fed wheat, oat, and barley straws. Some observations on nutrient compositions of straws are as follows.

- Energy contents of straw (total digestible nutrients; **TDN**) vary from 25% to 55%. While TDN contents of straw are low relative to high-quality forages like bud-stage alfalfa or well-eared corn silage, the TDN range for straws appears as wide as for other forages.
- Fiber digestibility, measured by neutral detergent fiber digestibility (NDFD, % of NDF) varies from 20% to 57%. About half of the straw samples contain enough energy to support growth or milk production.
- Potassium levels of straw range from 0.75% to 2.86%. Pre-fresh dairy rations are at times formulated to control dietary cation anion difference (**DCAD**) to prevent metabolic disorders like milk fever. Several of the straws sampled may not improve dietary DCAD status because of high potassium contents.

Tom Anderson, Shawano Co. Agricultural Agent
thomas.anderson@ces.uwex.edu
Patrick C. Hoffman, Extension Dairy Specialist
UW-Madison Dairy Science Department
Marshfield Agricultural Research
pchoffma@wisc.edu

Why does the nutrient composition of straw vary?

Straws in the Table were sampled from large stored stocks of straw intended to be fed to dairy animals. The samples were mechanically harvested and may include weeds or in some cases under-seeded legumes or grasses. Therefore, straw may not be perfectly homogeneous forage. Some grain may have also escaped from the combine, thereby increasing the energy density of straws. In addition straws vary in NDFD which influences energy content. In general oat straws appear to have slightly higher NDFD than barley or wheat straws.

What about the ash content of straw?

There is wide variability in the ash content of the straw. In addition to the indigenous minerals, exogenous minerals such as soil, or silica, maybe a major source of ash in straw. Dust and dirt that accumulate before or during harvest most likely account for samples with elevated ash contents.

Should straw be tested, or will book values do?

Do not use book values for straw as a reference nutrient composition in ration formulation. While straws are of low quality there is a relatively large range of quality. Therefore appropriate laboratory determination of nutrient composition is prudent Nutritionists may assume that all straws are of poor quality and unworthy of testing. While that is generally correct, the quality of

straw samples varies as widely as for high- quality forages.

What sort of testing is recommended for straw?

Dairy producers wishing to dilute energy-dense diets should test all key lots of straw. In general, there are few near-infrared reflectance spectroscopy (NIRS) equations to predict the nutrient content of straws and wet-chemistry forage analysis will be often required. Nutrition consultants and producers should check with their laboratory if NIRS prediction equations are available for straw that can be used with confidence. Wet-chemistry evaluations should include dry matter, crude protein, neutral detergent fiber, NDFD, fat and ash because these nutrients are required to calculate an accurate energy estimate for straws and energy is primarily the nutrient in question.

Producers that are concerned about DCAD levels in dry cow diets should opt for standard wet-chemistry mineral analysis. Wet-chemistry potassium, magnesium, and phosphorus analysis is typically more precise than NIRS due to limitations of spectra absorbance by minerals.

Producers considering purchase of a large lot of straw should consider the testing options listed above before purchase.

How should straw be sampled?

It is important that a proper protocol is used to sample straw to obtain a representative sample. Baled straws should be cored using a bale corer and electric drill obtaining 12-15 core samples. A lot of chopped straw should be sampled throughout the lot using gab-samples, filling a five-gallon pail, mixed well and sub-sampled. A final sample size of one quart to one gallon is sufficient for most laboratories.

Summary

The inclusion of forage straw in dairy diets can be a valuable nutrition management tool for dairy producers. Data collected in this field evaluation indicates that straws used as forage are of low quality but the nutritive value of straw can vary as much as other forages. It is recommended that nutrition consultants and producers routinely test straw before dietary incorporation. In addition, make certain that forage tests are appropriate to identify the nutrients of greatest interest, such as energy content or minerals for DCAD profiles. Carefully follow a good sampling protocol to provide a representative sample to the laboratory.

References

Hoffman, P.C, and D. Taysom. How much ash are you feeding your cows? Hoards Dairyman. Volume 149, No. 20:.659.

Undersander, D. et al. Sampling Hay and Silage for Analysis. UWEX A2309

© University of Wisconsin Board of Regents, 2006

Table 1. Nutrient composition of selected straws commonly fed to dairy cattle.

	Nutrient[1]													
	DM	CP	NDF	NDFD	NFC	Fat	TDN	NE_L 3x	RFQ	P	Ca	K	Mg	Ash
Straw Type	% as fed	% of DM	% of DM	% of NDF	% of DM	% of DM	% of DM	Mcals/lb	na	% of DM	% of DM	% of DM	% of DM	% of DM
Barley	92.3	5.5	74.5	43.4	12.8	2.2	44.4	0.44	57	0.25	0.49	1.64	0.16	7.3
Barley	93.4	5.2	74.7	42.8	14.1	1.9	44.2	0.44	56	0.29	0.52	1.60	0.16	6.5
Barley	93.6	2.4	82.7	33.1	7.6	1.8	30.8	0.29	28	0.19	0.33	1.09	0.17	7.8
Average(Barley)	**93.1**	**4.4**	**77.3**	**39.8**	**11.5**	**2.0**	**39.8**	**0.39**	**47**	**0.24**	**0.45**	**1.44**	**0.16**	**7.2**
Oat	93.0	3.5	71.0	57.5	16.8	1.9	53.7	0.54	90	0.31	0.27	2.32	0.16	9.2
Oat	93.8	4.1	81.5	48.9	7.9	1.9	44.9	0.44	58	0.17	0.18	1.01	0.07	7.0
Oat	93.2	2.5	81.1	48.5	8.6	2.2	44.4	0.44	57	0.14	0.35	2.12	0.11	7.9
Oat	93.3	6.5	75.5	44.8	9.8	2.2	43.8	0.43	57	0.19	0.51	1.68	0.19	8.4
Oat	92.9	7.1	78.2	45.0	6.9	2.0	42.4	0.42	53	0.22	0.39	1.86	0.17	8.2
Oat	93.6	4.0	76.1	42.5	10.1	2.4	40.7	0.40	50	0.15	0.45	2.74	0.16	9.8
Oat	93.1	4.7	76.5	42.8	8.3	2.5	40.3	0.39	50	0.27	0.29	2.86	0.14	10.4
Oat	93.1	6.2	78.7	38.9	6.6	1.9	36.7	0.35	41	0.20	0.24	1.78	0.16	9.0
Oat	93.9	4.5	74.6	35.8	12.0	1.8	36.3	0.35	40	0.36	0.18	2.68	0.14	9.6
Average (Oat)	**93.3**	**4.8**	**77.0**	**45.0**	**9.7**	**2.1**	**42.6**	**0.42**	**55**	**0.22**	**0.32**	**2.12**	**0.14**	**8.8**
Wheat	93.6	4.3	80.1	49.2	8.9	1.7	45.1	0.45	60	0.09	0.33	1.13	0.11	7.5
Wheat	93.9	3.7	74.7	44.5	14.5	1.7	44.1	0.44	57	0.14	0.27	1.56	0.11	7.7
Wheat	92.7	3.6	77.7	47.6	10.8	1.4	43.3	0.43	57	0.14	0.29	1.12	0.12	8.9
Wheat	93.2	4.0	77.5	46.8	9.6	2.0	43.1	0.42	56	0.08	0.20	0.99	0.12	9.4
Wheat	92.9	6.8	72.3	41.5	13.5	2.1	43.7	0.43	56	0.17	0.33	1.53	0.14	7.7
Wheat	93.5	6.6	78.1	44.2	8.4	1.7	42.0	0.41	52	0.13	0.26	1.76	0.14	7.6
Wheat	93.9	6.1	71.4	36.8	16.5	1.8	41.6	0.41	49	0.17	0.27	1.58	0.12	6.7
Wheat	92.8	3.0	83.0	45.8	5.9	2.1	40.7	0.40	49	0.10	0.25	0.94	0.09	8.4
Wheat	93.7	4.5	82.2	44.5	7.2	1.4	40.2	0.39	48	0.09	0.22	1.15	0.05	7.2
Wheat	94.7	4.5	78.0	41.6	10.9	1.1	39.3	0.38	46	0.11	0.19	1.38	0.13	7.9
Wheat	94.1	3.6	79.9	42.5	8.5	1.8	39.0	0.38	46	0.13	0.13	1.12	0.09	8.6
Wheat	93.4	4.6	78.1	38.3	10.5	2.3	39.2	0.38	43	0.15	0.26	1.44	0.13	6.9
Wheat	93.2	3.9	84.1	40.2	6.5	1.5	36.6	0.35	39	0.09	0.23	0.85	0.11	6.4
Wheat	94.3	4.4	82.3	38.6	9.4	1.0	36.9	0.36	39	0.12	0.20	0.75	0.08	5.3
Wheat	94.0	3.5	81.1	34.1	9.2	1.5	33.0	0.31	32	0.12	0.14	1.11	0.09	7.1
Wheat	93.9	4.9	78.0	31.6	10.5	1.3	32.1	0.30	31	0.14	0.25	1.30	0.10	7.8
Wheat	94.0	6.6	74.1	29.7	10.3	1.4	31.1	0.29	30	0.18	0.27	2.00	0.11	10.0
Wheat	93.8	4.4	80.0	33.1	8.1	1.4	31.2	0.29	30	0.30	0.20	1.52	0.11	8.6
Wheat	93.0	2.9	83.7	29.1	5.5	1.8	26.4	0.24	21	0.08	0.16	0.85	0.09	8.4
Wheat	94.0	5.2	80.0	20.5	9.7	1.6	24.3	0.22	16	0.17	0.20	0.65	0.16	6.0
Average (Wheat)	**93.6**	**4.6**	**78.8**	**39.0**	**9.7**	**1.6**	**37.6**	**0.36**	**43**	**0.14**	**0.23**	**1.24**	**0.11**	**7.7**
All Straws														
Average	93.48	4.60	78.16	40.76	9.86	1.78	39.23	0.38	46.72	0.17	0.28	1.50	0.12	7.97
Minimum	92.30	2.43	70.96	20.53	5.54	1.03	24.33	0.22	16.36	0.08	0.13	0.65	0.05	5.34
Maximum	94.68	7.07	84.09	57.51	16.81	2.54	53.74	0.54	89.61	0.36	0.52	2.86	0.19	10.36
SD[2]	0.53	1.27	3.58	7.29	2.87	0.38	6.19	0.07	14.13	0.07	0.10	0.58	0.03	1.20

[1] DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, NDFD = neutral detergent fiber digestibility (48 h in vitro), TDN = total digestible nutrients, NE_L = net energy lactation, RFQ = relative forage quality, P = phosphorus, Ca = calcium, K = potassium, Mg = magnesium.

[2] SD = standard deviation