Forage Quality Losses in Alfalfa Hay Stacks

***Glenn Shewmaker*[1]**

[1] Extension Forage Specialist
University of Idaho, Kimberly
Research & Extension Center

RATIONALE

Many producers don't understand the losses of mass and forage quality in hay stacks over a several month period. This study was conducted in 2015-2016 to quantify changes in forage quality parameters over a several month period. This paper provides information about the causes of hay losses in storage and how management can minimize the losses.

- Objectives:
  - Determine the forage quality loss in alfalfa and alfalfa-grass hay stacks during 6-months storage.
  - Evaluate the rates of change due to beginning moisture levels in hay.

Figure 1. Sampling stacks with a probe.

METHODS

Two first-cutting hay stacks were sampled by coring 10 bales on each side of stack at chest height.

- Stack A was first cutting alfalfa in 4ft x 4ft x 8ft bales with a tarp on top.
- Stack B was first cutting alfalfa hay in 4ft x 4ft x 8ft bales.
- A Delmhorst electronic moisture probe was used to determine bale moisture in the area before coring.
- A Star Quality Probe (0.5in diameter) was inserted to a depth of 14 inches in the butt end of bales: initial (soon after baling and stacking), once per month, and final.
- Cores from 5 bales were composited into each replication (blocks) and sampled once per month for 6 months. The composite cored sample, 5 from each of 4 blocks in the stack, was mixed, sealed in plastic bag, and submitted for grinding.
- Subsequent cores were extracted from the same bales about 6 inches from the previous core.
- Samples from each sampling site and date were dried for at least 1 hour at 150°F (65°C) and ground through a 1-mm screen in a Udy Cyclone mill.
- Forage quality analysis was by near infrared reflectance spectroscopy (NIRS).
- Prediction equations for crude protein (CP), neutral detergent fiber (NDF), and neutral detergent fiber digestibility (NDFD) were calibrated by wet chemistry by NIRS Consortium.

University of Idaho
College of Agricultural and Life Sciences

RESULTS

Initial moisture concentrations were 13.3% for stack A and 13.5% for stack B. Moisture declined to about 10% in October (very dry conditions and limited precipitation) then increased to 10-11% in winter. Ash and lignin increased in both stack A (Table 1) and stack B (Table 2), probably the result of microbial respiration using carbohydrates. Rate of change varies by stack (Figures 2, 3, 4).

Table 1. Stack A mean change in forage quality parameters from beginning to ending points of storage. Concentrations are expressed as a percent of dry matter except for NDFD30, NDFD48, and Lignin_NDF which are expressed as a percent of NDF.

Parameter	Mean change	Std Error	t Value	Pr > |t|
DM	-0.29	0.12	-2.52	0.087
CP	-0.91	0.42	-2.18	0.118
ADF	6.24	1.89	3.3	0.046
aNDF	6.57	1.75	3.75	0.033
dNDF30	-3.09	0.50	-6.13	0.009
IVTDMD30H	-11.71	1.38	-8.51	0.003
NDFD30	-13.76	1.78	-7.74	0.005
dNDF48	-2.41	0.72	-3.36	0.044
IVTDMD48H	-9.88	2.45	-4.04	0.027
NDFD48	-9.83	2.34	-4.21	0.025
Ash	7.37	2.32	3.18	0.050
Fat	-0.36	0.07	-5.21	0.014
Lignin	1.08	0.24	4.49	0.021
RUP	5.15	0.94	5.45	0.012
DMI	-0.36	0.08	-4.6	0.019
DDM	-3.77	1.14	-3.31	0.045
RFV	-26.09	5.92	-4.41	0.022
dIntake	-0.36	0.08	-4.6	0.019
NFC	-12.67	3.45	-3.67	0.035
dTDN	-17.45	4.05	-4.31	0.023
TDNlegume	-16.13	4.39	-3.67	0.035
RFQ	-52.80	9.53	-5.54	0.012
Lignin_NDF	0.76	0.14	5.43	0.012

Table 2. Stack B mean change in forage quality parameters from beginning to ending points of storage. Concentrations are expressed as a percent of dry matter except for NDFD30, NDFD48, and Lignin_NDF which are expressed as a percent of NDF.

Variable	Mean change	Std Error	t Value	Pr > |t|
DM	-0.17	0.06	-2.83	0.216
CP	1.07	0.17	6.29	0.100
ADF	-2.44	0.66	-3.72	0.167
aNDF	-2.86	0.90	-3.19	0.193
dNDF30	-1.58	0.26	-6.18	0.102
IVTDMD30H	-0.96	0.80	-1.2	0.442
NDFD30	-1.85	0.67	-2.77	0.220
dNDF48	-1.39	0.24	-5.79	0.109
IVTDMD48H	1.81	1.40	1.29	0.419
NDFD48	0.53	1.65	0.32	0.803
Ash	1.56	0.01	311	0.002
Fat	0.09	0.01	17	0.037
Lignin	-0.16	0.01	-16	0.040
RUP	0.17	1.19	0.14	0.910
DMI	0.11	0.05	2.22	0.113
DDM	1.04	0.34	3.03	0.056
RFV	7.77	3.08	2.52	0.086
dIntake	0.11	0.05	2.22	0.113
NFC	0.16	0.31	0.5	0.652
dTDN	-0.74	0.39	-1.87	0.159
TDNlegume	0.23	0.70	0.33	0.761
RFQ	3.90	2.89	1.35	0.269
Lignin_NDF	0.27	0.30	0.87	0.446

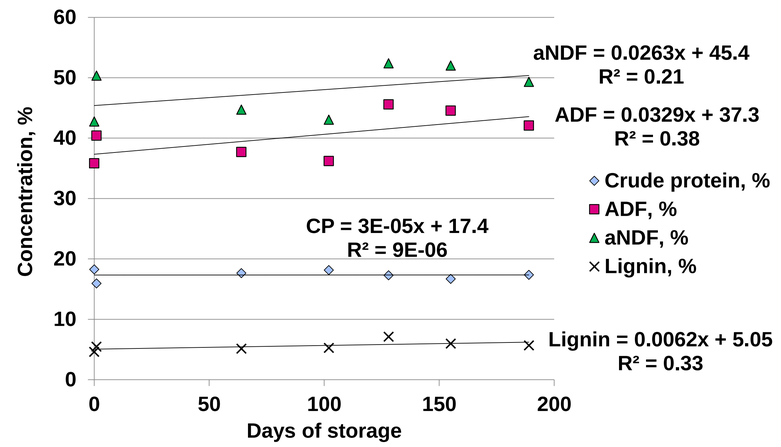

Figure 2. Forage quality rate of change of stack A.

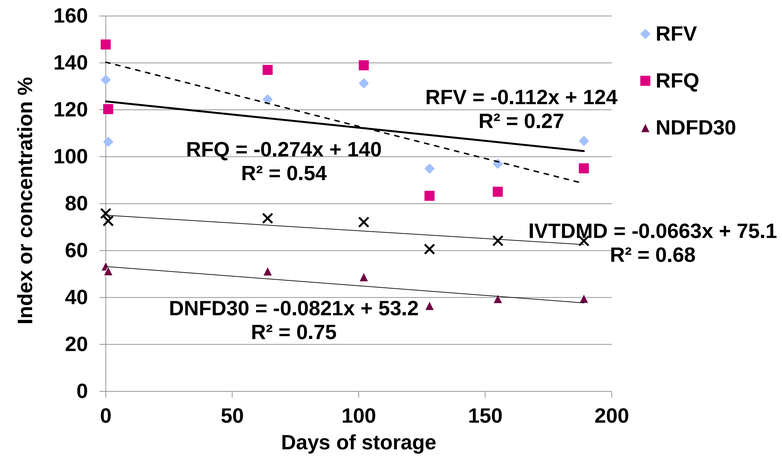

Figure 3. Forage quality rate of change of stack A.

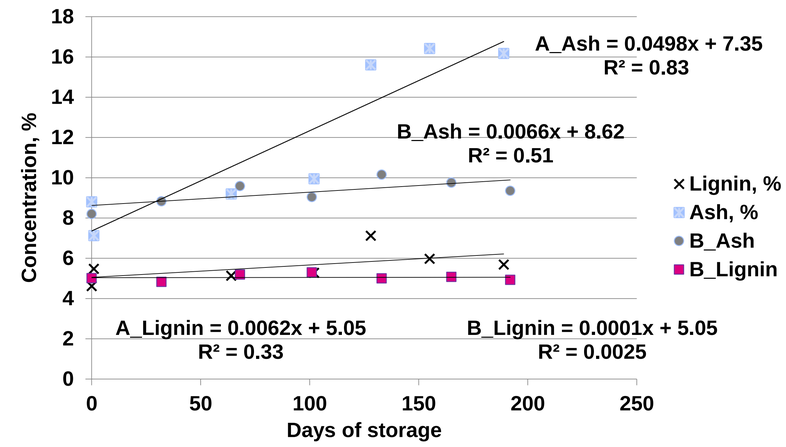

Figure 4. Ash and lignin rate of change of stacks A and B.

CONCLUSIONS

- Storage results in dry matter losses, lowered forage quality, and reduced feed intake and utilization.
- Ash and lignin concentrations increase with storage because of microbial respiration of carbohydrates.
- Well-formed, tight bales, and the proper moisture content will minimize storage loss.