

**HORSE PREFERENCE FOR ALFALFA-GRASS HAY HARVESTED IN THE AFTERNOON OR MORNING<sup>1</sup>**

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**ABSTRACT:** Cattle, sheep, and goats, prefer forage cut in the afternoon to that cut in the morning. This preference has been attributed to the presence of more sugar in the afternoon than morning forage. However, no quantitative studies have been reported for horse responses. We chose to test horses' preference for afternoon (PM) vs. morning (AM) cut alfalfa-grass hay grown in southeastern Montana. Mixed alfalfa-grass (alfalfa = 15 % bloom) was cut on 5 July 2002 at 1900 hr and again the next morning at 0700 hr using a swather with conditioner. Hay was air dried for 24 h and baled into 300 kg round bales. Bales were placed on pallets, tarped, and stored in a metal hay shed. Hay consisted of 70% Grimm alfalfa and 30% Fairway crested wheatgrass. Five kg of both hays (AM- and PM- cut) were offered *ad libitum* to each of five American Quarter horses for 10 minutes during the morning and afternoon. Both feeding order and position of feed buckets were randomized at each feeding. Dry matter intake was determined by weighing before and after feeding. Four samples of each bale were dried in a convection oven (60° C) and ground into a fine powder. One gram of powdered hay was combined with nine milliliters of distilled water, boiled for five minutes, and vacuum filtered through Whatman #1 qualitative paper. Sugars in the filtrate were determined using a hand held Bausch and Lomb 400SD refractometer having range of 0 - 60%. Data were tested with analysis of variance. Horses preferred the PM-cut hay by eating twice as much of the PM- as of the AM-cut hay ( $P = 0.001$ ). The sugar concentration was 170 mg/g greater in the extract from the PM-cut than from AM-cut hay ( $P = 0.04$ ). Horses are able to identify forage having greater sugar concentrations and will eat larger quantities of this hay.

Key words: Horses, Preference, Sugar, Diurnal Change, Forage Quality

**Introduction**

Ruminants, like cattle, sheep, and goats, prefer forage cut in the afternoon to that cut in the morning, presumably because of the greater sugar concentration (Fisher et al. 1999). A qualitative study by Mayland et al. (2001) reported that horses were able to discern the differences between morning and afternoon cut alfalfa. However, no quantitative studies have been reported for horses. The purpose of this study was to determine whether horses demonstrated a preference for an alfalfa-grass hay cut in the afternoon versus that cut in the morning.

**Materials and Methods**

The study was conducted on a family ranch located 23 km SW of Baker in southeastern Montana (104°31' W, 46°14' N). The elevation at the ranch was about 950 m. The hay field consisted of 70% Grimm alfalfa (15% flower) and 30% Fairway crested wheatgrass. The hay was cut on 5 July 2002 at 1900 hr and again the next morning at 0700 hr using a John Deere 2280 swather with conditioner. Hay was air dried for 24 hours and baled using a Massey Ferguson 450 round baler.

U.S. Bureau of Reclamation weather records from Terry, MT (Agrimet, 2003) indicate near-maximum radiation levels for the 5<sup>th</sup>, 6<sup>th</sup>, and 7<sup>th</sup> of July during which time the hay was cut (Table 1). Moderately high air temperatures also enhanced the drying. During this harvest period, some rainfall was reported at the Terry Agrimet station which is about 110 km NW of the ranch. However, no rainfall was recorded at the ranch for at least 3 days preceding swathing and continuing until the hay was in the barn. Therefore, ideal hay harvesting weather prevailed at the ranch.

Table 1. Climate readings for the days before and after hay was cut (USBR, 2003). 'Ranch ppt' data are from ranch records.

Dates (July 2002)	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>
Low Temp (°C)	12	22	17	15	19	16
High Temp (°C)	37	40	32	36	37	38
Precipitation (mm)	.43	.31	.00	.00	.15	6.50
Ranch, ppt (mm)	.00	.00	.00	.00	.00	12.7
Solar (langkeys)	555	654	722	699	679	669

<sup>1</sup>The study followed guidelines for animal care and use (Consortium 1988). Research was conducted while LCM was summering with family in South Eastern Montana. Preparation of the manuscript was partially supported by USDA-ARS. Correspondence should be addressed to Miss Linda C. MacKay, 6619 Los Altos, El Paso, TX 79912; Tele: 915-585-3454; e-mail: <[cowgirl4mouse@cs.com](mailto:cowgirl4mouse@cs.com)>

Bales (300 kg) were stored on pallets, tarped, and placed in metal hay shed. Hay was tested with a moisture probe to eliminate confounding variables. Four core samples were taken of each bale from top, top third, bottom and bottom third for sugar analysis. Five kg of both hays (AM- and PM-cut) were placed in buckets and offered *ad libitum* to five American Quarter horses for 10 minutes. This was replicated twice a day for four days in which the sequence of horses and position of hays were completely randomized. In addition to receiving 20 kg of test hay (5 kg of each hay, twice daily) horses were also fed an additional 20 kg hay each. Air dry matter intake was determined by weighing hay before and after each feeding.

Four samples of each bale were dried in a convection oven (60° C) for two weeks, then ground into a fine powder. One gram of sample was combined with 9 ml of distilled water and boiled for five minutes. This solution was vacuum filtered through Whatman #1 qualitative paper, using a Buchner funnel attached to an Erlenmeyer flask. Sugars in the filtrate were determined using a handheld Bausch and Lomb 400SD refractometer having range of 0 - 60%.

Data were analyzed using Analysis of Variance (Systat, 1999).

### Results

Horses consumed significantly more ( $P = .001$ ) of the PM- than AM-cut hay (Table 2). The least square means of consumed PM- and AM-cut hay were 0.63 and 0.31 kg/feeding. Hay consumption was not different among horses or between morning and afternoon feeding times. Sugar concentration in the PM-cut hay was greater ( $P = .038$ ) than in the AM-cut hay (Table 3). The hot water extracts of the PM-cut hay contained about 42 % while those from the AM-cut hay contained about 36% sucrose (Figure 1).

Table 2. Analysis of variance for hay consumption.

Source	SS	df	MS	F-ratio	P-value
Horses	0.98	4	0.247	1.521	0.21
PM vs. AM cut	1.85	1	1.853	11.403	0.001
Feeding Time	0.01	1	0.006	0.039	0.84
Horses*PM vs AM cut	0.56	4	0.140	0.860	0.50
Horses*Feeding Time	0.63	4	0.157	0.964	0.43
PM vs. AM*Feeding time	0.14	1	0.137	0.840	0.36
Horses*PM vs AM*Feeding Time	0.59	4	0.148	0.910	0.46
Error	8.21	50	0.162		

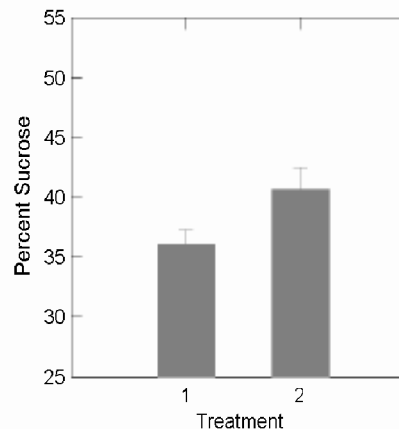


Figure 1. Sucrose concentration in extract, where treatment 1 is AM cut and treatment 2 is PM cut forage. Error bars represent standard error of mean.

Table 3. Analysis of Variance for sucrose concentration in the PM- vs the AM-cut forage.

Source	SS	df	MS	F-ratio	P-value
PM vs AM cut	105.8	1	105.8	5.0	0.038
Error	381.0	18	21.2		

### Discussion

Horses showed a preference for the PM-cut hay, which was the hay having the higher sugar levels. Therefore, horses can apparently distinguish between hays with differing sucrose levels. Since PM-cut hay is preferred, hay should be cut in the afternoon hours to optimize preference and dry matter intake. Results confirm findings available from ruminants (Fisher, et al. 1999).

In another study (Mayland et al. 1998), sugar concentrations were determined on fresh alfalfa plants sampled at different times of the day. In the morning hours, the sugar concentrations were low and increased throughout the day (light reaction of photosynthesis), reaching a climax in the evening and declining through the night by plant respiration and metabolism. They found that total nonstructural carbohydrates had the same diurnal pattern as the sucrose levels. Knowledge of this diurnal change in forage quality is relevant to agriculture because the afternoon harvesting is most desirable to cut hay having the best nutritional value.

### Literature Cited

- Consortium. 1988. Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. Consortium for Developing a Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. Champaign, IL.
- Fisher, D.S., H.F. Mayland, and J.C. Burns. 1999. Variation in ruminants' preference for tall fescue hays cut either at sundown or at sunup. *J. Anim. Sci.* 77:762-768.
- Mayland, H.F., J.C. Burns, D.S. Fisher, G.E. Shewmaker, R. Carlstrom, and D. S. Cash. 2001. Herbivore preference for afternoon- and morning-cut forages and adoption of cutting management strategies. p. 405-406. ID No. 09-42. Proc. XIX International Grassland Congress, 10-21 February, Piracicaba, SP - Brazil.
- Mayland, H.F., G.E. Shewmaker, J.C. Burns and D.S. Fisher. 1998. Morning and evening harvest effects on animal performance. pp. 26-30. In Proc. California/Nevada Alfalfa Symp., Reno, NV. 3-4 Dec. 1998.
- SYSTAT 9: Statistics I. Chicago, IL: SPSS Inc. 1999, 660 pp.
- U.S. Bureau of Reclamation. 2003. Agrimet Data System. AgriMet Site, Buffalo Rapids, Terry, Montana. 105 17 58W, 46 46 41N, 690m elevation. Internet <[wysiwyg://24http://www.gp.usbr.gov/agrimet/brtm.htm](http://www.gp.usbr.gov/agrimet/brtm.htm)>