Proceedings, Western Section, American Society of Animal Science

Vol. 59, 2008

FEEDING GRAIN DECREASES TRAINING EFFECTIVENESS IN 2-YEAR-OLD QUARTER HORSES

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ABSTRACT: Two replicated experiments (Exp. 1: May 14 to June 8; Exp.2: June 25 to July 20) evaluated effects of feeding grain to 2-yr-old Quarter horses on behavior and physiological parameters during early stages of training. In each experiment, 6 different horses were allotted by sex and weight to 2 diets; hay only or hay plus 2.3 kg/d grain. Horses were group-housed with ad libitum access to grass/alfalfa hay and water, and were individually fed 1.15 kg grain or 40 g salt (placebo) at 0800 and 1600 for 7 d prior to and during training. The trainer was blind to diet assignments. Horses were trained 5 d/wk for 3 wk and scored (1 to 5) by the trainer daily on obedience (willingness to ride with a loose rein and little leg pressure), life (willingness to move at any desired speed), and direction (suppleness in the poll and loin), while an observer scored fearfulness. A heart monitor recorded minimum, maximum, and mean heart rate daily during training. Categorical data were transformed by subtracting the daily median as each horse's score was relative to the other horses on that day. Data were analyzed as repeated measures (Proc Mixed of SAS) with horse as the experimental unit. In Exp. 1 grain did not affect (P = 0.83) obedience, while horses fed grain in Exp. 2 were less obedient during training (P = 0.02) than those not receiving grain. Horses fed grain showed greater (P = 0.05) fearfulness than horses fed hay alone. Life:direction (ideal is 1.0, > 1.0 indicates high self-preservation) was higher (P = 0.04) in horses fed grain than in those fed hay alone (1.29 vs. 1.08, respectively). Maximum heart rate was not affected (P = 0.21) by grain, while mean heart rate was higher (P = 0.03) for horses fed grain than hay alone (126 vs. 119 beats/min, respectively). Horses fed grain during training exhibited more self-preservation behavior, increased mean heart rate, and an unbalanced life to direction ratio, which could inhibit training effectiveness.

Key words: behavior, horses, training effectiveness

Introduction

Horses, being ridden by less experienced riders, need to be calm and easy to handle, characteristics that may be enhanced by more effective early training (Lansade et al., 2005). Behavior problems in horses often arise as a result of self-preservation. When the level of fear rises, then the horse's reasoning ability starts shutting down and defensive reactions start to surface (Black, 2005). Increased dietary energy was shown to increase the level of self-preservation in horses, resulting in less learning during training, and feeding grain has been suggested to cause excitable behavior (Greiwe et al., 1989). Horses fed grain had higher spontaneous activity, and greater reactivity to stimuli than horses fed energy in the form of fat (Holland et al., 1996), while learning performance was higher in calm horses (Kusunose and Yamanobe, 2002). Nervous horses, identified by having an increased heart rate (McCann et al., 1988), were found to be less trainable, as indicated by the negative correlation between higher levels of emotionality and the number of trials to criterion in a learning study (Heird et al., 1981). It is common in today's equine industry to feed young and growing horses grain once or twice a day (Steelman et al., 2006) with the potential of reducing training effectiveness.

The purpose of this study was to determine the effect that feeding grain to 2-yr-old Quarter horses had on measures of training effectiveness (obedience, self-preservation behavior, heart rate, and time to achieve training satisfaction).

Materials and Methods

Animals, Design and Treatments

Procedures were approved by the Montana State University Institutional Animal Care and Use Committee. A total of 12 Quarter horses (24 to 28-mo-old; 4 geldings, 8 fillies; 417 ±27.5 kg initial BW) were group-housed in two 30.5 x 45.7 m pens (6 horses per pen). In each of 2 experiments, 6 different horses were allotted by sex and weight to 2 treatments (3 horses•treatment^{-1}•experiment^{-1}). All horses had ad libitum access to grass/alfalfa hay and water.

Two replicated experiments (Exp. 1: May 14 to June 8; Exp.2: June 25 to July 20) were conducted testing the effect of 2 dietary treatments, hay only or hay plus 2.3 kg/d grain (commercial mixture of corn, oats, barley, and molasses; as-fed basis), on training effectiveness. Horses were placed in individual 3 x 3 m pens and fed 1.15 kg grain or 40 g salt (placebo) at 0800 and 1600 for 7 d prior to and during training. After the grain was consumed at each feeding, the horses were turned back out into the large pen. Each experiment consisted of 26 d, with 7 d for diet adaptation followed by 19 d of data collection. Within the data collection period, horses were ridden and trained 5 d/wk for 3 wk for a total of 15 d training. The trainer was blind to diet assignments. Both experiments utilized the same procedures.

Training Effectiveness

Effective training was defined as when the horse had: 1) a solid foundation of maneuvers, 2) a balanced life to direction ratio, 3) willing submission, and 4) low levels of self-preservation. During each training session, the following components were measured:

Solid Foundation of Maneuvers. A solid foundation of maneuvers consisted of 3 stages: stopping forward motion pivoting around inside front foot, lateral movement of shoulders and hindquarters together, and stopping forward motion pivoting around the inside hind foot. Foundation of maneuvers was defined as the horse's willingness to move the front feet and the hind feet in any direction to accomplish any job. On d 15 to 19, and d 22 to 26, the trainer scored each horse on a scale from 1 to 5 (1 = very unwilling; 5 = very willing) on willingness to move the front feet and the hind feet.

Life and Direction. Life was defined as the willingness of the horse to move with any speed at any time; get-up-and-go, or liveliness. The trainer scored life on d 15 to 19, and d 22 to 26 on a scale of 1 to 5 (1 = drive spurs into belly to get movement, constant pressure; 5 = very free, fan legs or light pressure with calves).

Direction was defined as when the slack was taken out of the rein, the horse put the slack back in the rein for horizontal and vertical flexion, with suppleness through the poll and loin. The trainer scored direction on d 15 to 19, and d 22 to 26 on a scale from 1 to 5 (1 = fighting; when slack was taken out of the rein the horse flipped or shook his head; 5 = total agreement; when the slack was taken out of the rein the horse immediately put the slack back in the rein seeking relief).

The life to direction ratio was calculated by dividing the daily score for life by the daily score for direction. A balanced life to direction ratio was defined as being able to willingly bring the life up and direct it, and was considered numerically close to 1.0. A ratio greater than 1.0 indicated that the life was greater than the ability to direct it, and signified lack of control of the horse.

Willing Submission. Willing submission was measured by observations of obedience, and time to achieve training satisfaction. Obedience was defined as after an initial cue, the horse performed the task on a loose rein, with no leg pressure; it was the horse's idea. Obedience was scored on d 11 to 12, d 15 to 19, and d 22 to 26 by the trainer on a scale from 1 to 5 (1 = lack of obedience; 5 = completely obedient).

During each training session, d 8 to 12, d 15 to 19, and d 22 to 26, the trainer recorded the amount of time it took to reach training satisfaction for that day. Training satisfaction was defined as the horse had improved from the day before in building a solid foundation of maneuvers, balancing the life to direction ratio, and attaining willing submission. Time spent training on the ground, and time to saddle the horse before riding were also recorded.

Self-Preservation. Self-preservation was measured through heart rate (HR), locomotor activity, fearfulness, reaction to social separation, and response to a novel stimulus, in this case a flag. Heart rate was recorded during each training session with a Polar S810i model HR monitor (Polar Electro Oy, Kempele, Finland) that consisted of 2 electrodes, a built-in transmitter, and a wrist watch receiver (Visser et al., 2002). The electrode belt was specially made to fit horses. The data received were stored and later downloaded via a Polar InfraRed Interface to a computer, using Polar Equine Software 4.0. Data were recorded as average HR every 5 sec during the training session as well as the mean and maximum HR. A pedometer was used to measure locomotor activity during training. An observer scored the horses during training on d 8 to 12, d 15 to 19, and d 22 to 26 from 1 to 5 on fearfulness (1 = no signs; 5 = high levels, bucking), and on d 8 scored the horses on response to a flag (1 = calm; 5 = highly excitable). Reaction to social separation was scored by the trainer on d 16, 17, and 19, which were the first solo rides outside the arena, away from other horses. Horses that lack confidence in the rider will seek comfort and companionship with other horses by constant vocalizations. Horses were scored on a scale from 1 to 5 (1 = constant whinnying; desperately looking for other horses; 5 = no vocalization, confident in rider, not concerned with other horses).

Statistical Analyses

Categorical data were transformed by calculating each daily score as a deviation from the daily median of that parameter as each horse's score was relative to the other horses on that day. All data were analyzed using repeated measures analysis with the Mixed procedure of SAS (SAS Inst. Inc., Cary, NC). Covariance structure was modeled for each parameter. The model included effects of experiment, treatment, day, and all possible interactions. Data are presented as least squares means with differences considered significant at $P < 0.10$.

Results and Discussion

Solid Foundation of Maneuvers. The ability to move the horse's front feet or hind feet in the foundation of maneuvers was not affected ($P > 0.17$) by diet. When a horse's self-preservation is high they become stiff through the poll and loin, which can cause poor direction. However, although the poll and loin may be stiff, the horse's feet can still be directed in the foundation of maneuvers; forward, backward, and laterally.

Life and Direction. Life was greater ($P = 0.09$) for horses fed grain compared with horses fed only hay. Diet or experiment did not affect ($P > 0.93$) direction. However, the life to direction ratio was more ($P = 0.07$) unbalanced (defined as > 1.0) in grained horses than in horses fed hay alone (average 1.28 vs. 1.08, respectively). An unbalanced ratio indicates poor control in relation to life and can cause numerous problems during training. The further a horse's life to direction ratio exceeds 1.0, the more self-preservation increases, and behavior problems may surface. To prevent behavior problems in young horses and possible injuries for unconfident riders, the ideal situation would be to have a balanced life to direction ratio. Our study suggests that feeding grain to horses resulted in a more unbalanced life to direction ratio compared to horses fed hay only.

Willing Submission. Experiment x treatment interactions were observed for obedience ($P = 0.02$), total time to achieve training satisfaction ($P = 0.005$), and ground time ($P = 0.02$). In Exp. 1, grain did not affect ($P > 0.10$) obedience, while horses fed grain in Exp. 2 were less obedient during training ($P = 0.02$) than those not receiving grain. Total time to achieve training satisfaction was increased ($P = 0.005$) by 20%, and time spent training on the ground before riding was increased ($P = 0.02$) by 40% by feeding grain in Exp. 2, but were not different ($P > 0.10$) due to diet in Exp. 1. The time it took to saddle the horses was increased ($P = 0.07$) by 42% in Exp. 2 compared with Exp. 1, indicating more time was required before the horses' self-preservation levels were decreased enough to proceed with mounted training.

The experiment x treatment interactions may have been due to an increased BCS in horses in Exp. 2 compared with horses in Exp. 1. When the horses were initially allotted to their assigned treatments, the groups weighed the same. However, by the time Exp. 2 was conducted, the second group of horses, who had been eating hay ad libitum and were not being ridden, weighed 19 kg more ($P < 0.001$) than the horses in Exp 1, approximately equivalent to 1 BCS (NRC, 2007). Average daily gain during Exp. 1 was not different ($P > 0.10$) between diets (average 0.58 kg), whereas ADG during Exp. 2 was less ($P = 0.004$) for horses fed hay alone compared with those fed grain (-0.08 vs. 0.08 kg, respectively), and less ($P < 0.001$) than ADG in Exp. 1. This suggests that horses in Exp. 2 worked harder or expended more energy than horses in Exp. 1, resulting in a longer time to achieve training satisfaction. McCall (1989) found that horses with a higher body condition score were distracted more easily during discrimination testing than horses with a lower BCS. As long as horses are maintained in moderate body condition, these results suggest that trainers under time constraints could increase their training effectiveness during the early stages of training by not feeding excess dietary energy.

Self-Preservation. Minimum HR during training was greater in grained horses ($P = 0.003$) during Exp. 2, suggesting a higher level of self-preservation compared with horses fed only hay. No difference ($P > 0.10$) in minimum HR was seen due to diet in Exp. 1. Horses in Exp. 2 had a higher ($P = 0.01$) mean HR during training than horses in Exp. 1 (average 127 vs. 117 beat/min, respectively), another indication that horses in Exp. 2 worked harder than those in Exp. 1. Maximum HR during training was not affected ($P > 0.21$) by diet or experiment (average 208 beats/min). Mean HR has been shown to be highly correlated with behavioral estimates of self-preservation in horses (McCall et al., 2006). Self-preservation is one of the horse's primary driving factors and may be the greatest limiting factor when training horses (Murphy and Arkins, 2007).

Fearfulness levels were higher in grained horses ($P = 0.05$) than in horses fed only hay. Horses fed grain had higher incidences of bucking and running compared to horses fed hay alone. Fiske and Potter (1979) reported high levels of fearfulness reduced learning ability in yearling horses. High levels of self-preservation not only decrease training effectiveness, but may lead to injury of the rider or the horse (Warren-Smith et al., 2005).

The locomotor activity during a training session was 20% greater ($P = 0.008$) for horses fed grain compared to those fed only hay in Exp. 2, while no difference ($P > 0.10$) in steps per session was seen due to diet in Exp. 1. Increased step count suggests a greater level of nervousness during training and nervous horses have been shown to be less trainable (Heird et al., 1981).

There was an experiment x treatment interaction ($P = 0.09$) for reaction to social separation. Horses fed grain in Exp. 2 showed more signs of whinnying and desperately wanting to return to the other horses, indicating a lack of confidence in the rider compared with horses fed hay alone. Horses are driven by comfort and companionship (McGreevey, 2007); if this cannot be found with the rider horses become unconfident and insecure. Horses without security in the rider may be more difficult to train because they are not focused on the rider's cues; instead focusing on seeking comfort and companionship with other horses.

An experiment x treatment interaction was observed for the response to a flag ($P = 0.07$). Horses fed grain in Exp. 2 demonstrated more self-preservation behavior during exposure to a flag on the first day of training compared with horses consuming hay only, while no difference was observed due to diet in Exp. 1. Holland et al. (1996) found horses fed energy in the form of fat had lower reactivity in a startle test, measured by abruptly opening a brightly colored umbrella, compared with horses fed grain.

Willing submission is a key factor in starting young horses. Horses that do not submit willingly may become resentful to commands and dangerous to their riders. Horses in training programs are often ridden for a defined period of time. These results suggest that training satisfaction may be reached sooner if horses are maintained in moderate body condition, and not fed excess dietary energy.

Implications

These findings imply that feeding grain during the early stages of training decreased training effectiveness in 2-yr-old Quarter horses by increasing self-preservation behavior, decreasing willing submission behavior, and causing an unbalanced life to direction ratio.

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Table 1. Effects of feeding grain on measures of self-preservation behavior, willing submission behavior, and training effectiveness in 2-year-old Quarter horses

	Treatments[1]							
	Exp. 1		Exp. 2			*P*-values		
Item	No grain	Grain	No grain	Grain	SEM	Exp	Trt	Exp x Trt
n	3	3	3	3				
Initial wt, kg	405.8	407.5	425.5	426.1	3.87	<0.001	0.76	0.88
ADG, kg	0.58[c]	0.57[c]	-0.08[a]	0.08[b]	0.028	<0.001	0.01	0.004
Foundation of maneuvers								
Front feet[2]	-0.49	0.06	-0.06	-0.03	0.196	0.40	0.17	0.22
Hind feet[2]	-0.09	0.13	-0.13	-0.03	0.249	0.72	0.54	0.82
Life and direction indices								
Life[2]	-0.19	0.08	-0.43	0.23	0.269	0.88	0.09	0.48
Direction[2]	-0.05	0.02	0.04	-0.08	0.286	1.00	0.93	0.75
Life:direction	1.15	1.31	1.01	1.25	0.108	0.40	0.07	0.73
Willing submission indices								
Obedience[2]	-0.24[a]	0.17[ab]	0.41[b]	-0.24[a]	0.22	0.59	0.59	0.02
Total time, min	34.3[ab]	31.4[a]	31.1[a]	37.4[b]	1.60	0.41	0.27	0.005
Ground time, min	11.7[a]	10.8[a]	11.2[a]	15.7[b]	1.15	0.09	0.13	0.02
Time to saddle, min	5.0	5.5	6.5	8.4	1.06	0.07	0.31	0.53
Self-preservation indices								
Minimum HR, bpm	53.8[a]	54.5[a]	54.4[a]	69.5[b]	1.65	0.002	0.002	0.003
Mean HR, bpm	115.5	118.8	121.2	132.6	3.11	0.01	0.02	0.19
Maximum HR, bpm	203.9	208.5	204.9	213.8	4.94	0.54	0.21	0.68
Activity, steps	3,239[bc]	2,895[ab]	2,831[a]	3,391[c]	166.5	0.80	0.52	0.008
Fearfulness[2]	0.09	0.36	-0.01	0.34	0.137	0.69	0.05	0.75
Social separation[2]	-0.14[ab]	0.31[ab]	1.03[b]	-0.36[a]	0.470	0.61	0.34	0.09
Response to flag[2]	0.17[ab]	-0.83[a]	-0.50[a]	1.17[b]	0.646	0.33	0.62	0.07

[1] Two experiments with horses having ad libitum access to hay and supplemented with 0 kg/d (No grain) vs. 2.3 kg/d (Grain) commercial grain mix. Six different horses were used in each experiment.
[2] Scored as 1 to 5; units are deviations from daily median for that parameter.
[a-c] Within a row, means without a common superscript letter differ ($P < 0.10$).