Journal of Equine Veterinary Science 31 (2011) 124-128

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Original Research

Effect of Feed Processing Method on Average Daily Gain and Gastric Ulcer Development in Weanling Horses

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Keywords:
Growth
Horse
Pelleted diet
Stomach ulcers

A B S T R A C T

The present study evaluated the effects of two different methods of feed processing on growth and gastric ulceration in 16 weanling Standardbred horses. The two diets were composed of identical ingredients that were processed differently and fed at a rate of 3% body weight per day. The hay and grain diet (diet HG) consisted of 50% alfalfa hay cubes and 50% commercial texturized grain mix fed as is, without any further processing, with the cubes and grain fed in separate containers. The complete pelleted diet (diet CP) consisted of the same proportion of hay cubes and grain mix, which was ground, pelleted, and fed in a single container. The horses were divided into two groups and the study was divided into three periods of 30 days each. During period 1, all 16 horses consumed only free choice alfalfa hay (diet H). Group 1 was given diet CP during period 2 and diet HG during period 3. Group 2 was given diet HG during period 2 and diet CP during period 3. The horses were endoscopically examined for the baseline number and severity of stomach ulcers at the end of period 1, then again at the end of each treatment diet feeding period. Horses on diet CP in periods 2 and 3 had greater ulcer numbers ($P = .0135$) than diet HG. However, there was no significant difference ($P = .30$) in ulcer numbers when making a direct comparison between diets CP and HG. Despite the gastric ulceration found in horses on diet CP, the average daily gain was significantly greater ($P = .016$) for diet CP than for diet HG. Both diets containing grain were observed to cause gastric ulceration.

1. Introduction

Gastric ulcers are a significant problem in equine populations because of their high incidence and potentially detrimental effects on performance. Horses in heavy training are particularly vulnerable, with an estimated 58% of show horses [1] and 93% of racehorses [2] being affected. Neonatal foals are also at risk, with an estimated 25% to 50% developing gastric lesions [3] either as primary disease or secondary disease [4]. Equine gastric ulcer syndrome (EGUS), ulceration and lesion formation in the distal esophagus, glandular and nonglandular stomach, and proximal duodenum [5], is a widespread condition that leads to decreased productivity and consequent economic loss. EGUS is a complicated disease process which involves many variables and can be difficult to diagnose and manage; horses may or may not show clinical signs, and typically exhibit vague negative effects such as weight loss, abdominal pain, and poor performance [6].

Equine gastric ulcers are associated with low gastric pH and overproduction of stomach acids. Horses secrete hydrochloric acid continuously and several factors can influence the level of acid production and epithelial exposure to these acids, including stomach anatomy, diet, restricted feed intake, exercise, stress (stall or transport),

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doi:10.1016/j.jevs.2011.01.001

and use of nonsteroidal anti-inflammatory drugs [7]. Weaning is one of the most stressful periods in a foal's life. Separation from the mare can cause stress and predispose weanlings to disease, injury, and reduced growth rates [8]. Additionally, the months after weaning are a crucial time for the producer as sales of weanlings and yearlings is a large source of income for the horse industry; thus, optimizing growth rates and maintaining good health during this time is important.

The intensively trained horses most prone to gastric ulcers are typically fed high-concentrate diets that are high in hydrolyzable carbohydrates. These carbohydrates produce large amounts of volatile fatty acids when broken down which can damage the protective barriers of the nonglandular epithelium, allowing hydrochloric acid to irritate and ulcerate the tissue [9]. On the basis of our observation of the horses in the study, it was noted that horses eating the hay and grain diets (diet HG) tended to bolt their grain and eat the hay more slowly, whereas those on the pelleted diet tended to eat at a more steady rate over several hours. This may help moderate and neutralize gastric pH. Although one study found no difference in gastric pH 8 hours after a meal of either textured grain or pelleted grain [10], no research has compared processed feeds with those which incorporate roughage.

Several studies have examined the relationship between all-hay diets and hay and concentrate diets in ulcer formation [11,12] and found a negative effect on the gastric health of horses being fed concentrates as opposed to those on strictly hay diets. However, no research has focused on gastric ulceration in horses fed differently processed feeds. In addition to managing diet to reduce the incidence of digestive and orthopedic diseases which have been linked to high dietary soluble carbohydrate levels [13,14], producers are striving to find the feeding methods which optimize growth while maintaining overall health. This study was conducted to determine the difference between a diet of hay and grain fed separately and an identically composed hay/grain diet processed in complete pelleted form, in gastric ulcer formation in young growing horses that had previously consumed an all-forage diet. We hypothesized that horses being fed a pelleted diet would develop fewer gastric lesions and have a higher average daily gain (ADG) as opposed to those being fed a mixed hay and grain ration; this is because pelleted diet would be consumed more slowly and at a more regular rate and the processing would increase feed digestibility.

2. Materials and Methods

Sixteen Standardbred weanlings were used in this experiment (six colts and 10 fillies) in a switchback design to evaluate the effects of hay cubes and grain fed separately versus complete pellets on growth and stomach ulcers in young, growing horses. The horses were selected from the University of Illinois (Urbana-Champaign, IL) herd and were all foaled and raised in the same facilities and were in good health at the start of the study. They were between the ages of 7 and 11 months and had been weaned approximately 2 months prior to the start of the study. Foals were weaned with familiar pasture mates, and the dams of older foals were removed first, as foals reached 5 to 6 months of age. The horses were divided into two equal treatment groups, randomly allotted within sex, to ensure that five fillies and three colts were present in each group. The horses were kept in individual runs with exercise areas of approximately 750 feet^2 per horse and provided run-in sheds for shelter. The sheds were bedded with wood shavings and the remaining area of the runs was covered with soil. No vegetation of any kind grew in the runs; water and salt and mineral blocks (MoorMan's Gro-Strong, Quincy, IA) were provided ad libitum. Feed was given in plastic feeders, with rubber mats placed underneath to collect wastage. Each horse was dewormed on the first day of period 2. This study was approved and performed under the guidelines adopted by the University of Illinois Institutional Animal Care and Use Committee.

2.1. Diet Treatments

The horses were fed 3% of their body weight was divided into two equal feedings given at 7:00 A.M. and 7:00 P.M. The nutrient content of the two diets is shown in Table 1, as determined by Equi-analytical Laboratories^R of Ithaca, NY, using traditional chemical assays. Complete pelleted diet (diet CP) consisted of a 50:50 proportion of alfalfa hay cubes (Norstar Industries, Auburn, WA) and a commercial texturized sweet feed (Purina Omolene 200; Purina Mills St Louis, MO), by weight, which was ground and processed into a complete pelleted feed. During processing, the two feeds were ground and mixed together in a tub grinder and then steam heated at 77°C for several minutes while being forced through a pellet dye. Diet HG was a mixed diet consisting of hay cubes and grain using the same ingredients, 50% alfalfa hay cubes and 50% grain by weight, which were fed separately.

The study was divided into three 4-week periods. During period 1, all of the horses were fed an alfalfa hay diet (H) with no grain supplementation. At the start of period 2, each group was assigned to one of the two diet treatments that were fed for the duration of the period. Group 1 was fed diet CP during period 2, then diet HG during period 3. Group 2 was given diet HG during period 2 and diet HG during period 3. Each diet was fed for 28 days.

2.2. Gastric Endoscopy

Each horse underwent three gastric endoscopies with a fiber optic scope. The examinations were conducted under sedation with xylazine (0.4 mg/kg IV) to identify any gastric lesions present. A veterinarian experienced in gastric endoscopy and scoring of gastric ulceration, who was blinded to the current diet of each horse, performed

Table 1
Nutrient content of diets, as fed

Analysis	Complete pellets	Hay cubes	Grain
% Moisture	12.32	12.24	12.40
% Dry matter	87.68	87.76	87.60
% Crude protein	13.00	12.13	13.87
% Acid detergent fiber	20.85	35.40	6.30
% Neutral detergent fiber	30.85	47.70	14.00
Digestible energy (Mcal/kg)	2.55	2.10	3.01