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Original Research

Chopping Hay Before Feeding Does Not Influence Fecal Particle Size, Blood Variables, or Water Intake in 3-Year-Old Arabians

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ABSTRACT

Previous work suggested that feeding chopped roughage, rather than long-stem, may influence thermoregulation during prolonged exercise, potentially by reducing hindgut particle size, thereby influencing water dynamics. This study aimed to determine if chopping hay affects fecal particle size (FPS), packed cell volume (PCV), plasma total solids (TS), and fecal dry matter (FDM). Six 3-year-old Arabians were divided into two groups and initially, for acclimation, fed either long-stem alfalfa hay or the same hay chopped (3–6 cm length) for a week each in a cross-over design; in weeks 3 and 4, this cross-over repeated. On days 6 and 7 of weeks 3 and 4, water consumption was measured over 48 hours, feed intake time was recorded, and PCV plus TS were measured at 0, 30, 60, 90, 120, 150, and 180 minutes after feeding. Fecal samples were collected each morning during weeks 3 and 4 to determine FDM and FPS. Packed cell volume and TS increased over the 3-hour sampling period ($P < .01$), but chopping the hay had no effect on the hay intake time, PCV, or TS. Water consumption and FDM did not differ between treatments ($P = .9$; $P = .24$) and there was no effect of treatment on FPS ($P = .50$). Only 10% of the fecal particles did not pass through the largest 2.36 mm sieve and 44% passed through the 150 μm sieve, suggesting marked reduction in particle size during the digestive process regardless of original hay intake length. Chopping hay did not have an impact on measured variables including FPS.

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1. Introduction

Endurance horses fed a diet containing chopped forage displayed a lower core body temperature during bouts of exercise compared with those receiving a diet containing long-stemmed forage—suggesting particle size of feedstuffs could be an influential factor in the hydration of horses subjected to endurance exercise [1]. Naylor et al [2] reported a decrease in horse's ability to properly thermoregulate when subjected to isotonic and hypertonic dehydration, compared with those horses subjected to euhydration—providing a model for the important role that hydration plays in thermoregulation. Increased surface area of hay particles by chopping may allow for greater absorption of water by the fiber and subsequent release of water when undergoing microbial fermentation; thus, the increased availability of water from the gut may improve hydration and increase the ability to thermoregulate [1].

An Australian research group investigated whether feeding Shetland ponies chopped timothy hay offered a nutritional advantage over the traditional long-stem form [3]. Analysis of forage, fecal matter, and urine indicated chopping timothy hay did not alter the composition or

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digestibility of organic matter, fiber, or energy and concluded that chopping long-stem forage offered no nutritional advantages to horses. Although chopping hay may not offer a nutritional advantage, mixing chopped hay (CH) to a grain diet has been shown to slow passage rate in ponies. Ponies fed diets consisting of a 70:30 CH:barley diet had slower passage rate through the intestinal tract than ponies fed a 50:50 hay:barley diet [4].

It is unclear if there is an actual difference in the particle size reaching the hindgut when feeding chopped as compared with long-stem hay (LH). Examination of differences in fecal particle size (FPS) from horses fed both CH and LH may provide an answer. If FPS is smaller when horses are fed CH, it would provide strong evidence that the particle size of feedstuffs reaching the hindgut is decreased more by chopping the hay than by mastication alone.

The objective of this study was to determine if feeding CH, opposed to feeding it in its long-stem form, resulted in measurable differences in FPS, fecal dry matter (FDM), hay consumption time, water intake, total plasma solids (TS), and packed cell volume (PCV). It was hypothesized that chopping hay would decrease FPS and alter total plasma solids and PCV.

2. Materials and Methods

Six 3-year-old Arabian fillies (430 ± 8 kg) were pair-matched by weight and randomly divided into two groups of three horses each. This study was conducted in early spring and before the study, horses had been housed on pasture with free choice access to hay. Within 3 months of the study, all horses underwent a thorough dental evaluation and were given remedial treatment as required as well as the appropriate anthelmintic treatment. The horses were housed in 3 × 3 m box stalls at the Michigan State University Horse Teaching and Research Center. Horses were provided *ad libitum* access to water and a trace mineralized salt block throughout the study. Horses received daily light exercise as part of a horse training class. Exercise consisted of either 30 minutes lunging or 30–45 minutes of riding on the flat in an indoor arena daily. All procedures were approved by MSU's All University Animal Care and Use Committee.

A single batch of second cutting alfalfa hay, sufficient to feed the project horses for 1 month, was secured, sampled, and analyzed via wet chemistry (Equi-Analytical; Table 1). Half of the hay was chopped using a commercial forage chopper (FP230 Forage Harvester, New Holland Agriculture, New Holland, PA) to a particle size of approximately 3–6 cm. The remaining hay remained unchopped so that the treatments for this study were the two forms of hay—either CH or LH. The stem length of the LH ranged from 20 to 40 cm. Horses were acclimated to the two forms of hay by feeding group one (G1) the long-stem form of hay, whereas group two (G2) was fed the chopped form for 1 week at the rate of 2% body weight (BW) (as fed) per day or approximately 4.2 kg of hay per feeding. All horses were fed at 7 AM and 4 PM each day. During week 2, the form of hay was switched and each group was fed the opposite form of hay for 1 week. The purpose of this acclimation period was to allow the horses time to familiarize themselves to the two forms of the same hay and to ensure they were consuming sufficient quantities with minimal orts. During week 3, groups were switched back to the initial form of hay and remained on that treatment for 1 week of testing. During week 4, groups switched treatments for the last time and completed a second week of testing. Orts were collected and weighed back before each feeding every day for the duration of the study. Horses were weighed and body conditioned-scored [5] on the first day of each week and feeding rate was adjusted after the first 2 weeks, if horses did not consume the full 2% of BW or were found to be losing weight or body condition score. After the first 2 weeks, all horses were increased to 2.25% BW as a result of a slight drop in BW between weeks 1 and 2. During the 2 weeks of testing, the amount provided to each individual horse remained constant at 2.25% of BW. Heart girth and abdominal circumferences were measured with a flexible measuring tape for the first 4 days of each week. Heart girth circumference was taken approximately 5 cm caudal to the elbow, whereas abdomen circumference was taken between the third and fourth most caudal ribs.

Table 1
Nutritional analysis[a] of the hay on a dry matter basis.

Nutritional Content	Hay
DM, %	94.0
DE, Mcal/kg	2.51
CP, %	21.9
ADF, %	32.4
NDF, %	39.4
Lignin, %	7.1
WSC, %	6.2
ESC, %	4.9
Starch, %	0.9
NFC, %	28.9
Crude fat, %	1.7
Ash, %	8.1
Ca, %	1.35
P, %	0.3
Mg, %	0.3

Abbreviations: ADF, acid detergent fiber; CP, crude protein; DE, digestible energy; DM, dry matter; ESC, simple sugars; NDF, neutral detergent fiber; NFC, non-fibrous carbohydrates; WSC, water soluble carbohydrates.
[a] Nutritional analysis was performed via wet chemistry by Equi-Analytical, Ithaca, NY.

After 2 weeks of treatment adaptation, testing procedures were implemented during weeks 3 and 4. Fecal samples were obtained from the horses between 7 AM and 9 AM daily. Horses were monitored until they defecated, and then a clean, bedding-free sample was reserved in a plastic bag at −20°C for analysis. On days 6 and 7 of weeks 3 and 4, total water consumption was measured for 48 hours. Horses had two 19 L buckets of water placed side by side in their stall, and water was measured gravimetrically every 8 hours. Water buckets were checked every 4 hours to ensure adequate water at all times. In addition, on days 6 and 7, consumption time of 1.5 kg of the respective treatment hay was monitored beginning at 7 AM. Exactly, 1.5 kg of the respective treatment hay was weighed for each horse. Hay was placed into a clean 66-L plastic tub that rested on the stall floor and was attached to an eye hook in the stall wall using a double-ended snap. To monitor feed

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