Journal of Equine Veterinary Science 36 (2016) 83–89

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Original Research

The Effect of Deworming on Apparent Digestion, Body Weight, and Condition in Heavily Parasitized Mares

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ARTICLE INFO

Article history:
Received 23 June 2015
Received in revised form 1 October 2015
Accepted 12 October 2015
Available online 23 October 2015

Keywords:
Cyathostome
Equine nutrition
Deworming

ABSTRACT

The objective was to evaluate the influence of endoparasitic infection on the apparent digestion of nutrients, body weight and condition, and blood indices in horses to test the hypothesis that all indices would improve in horses after deworming. Nineteen mares that had not been dewormed in the last 12 months were used. The mares were assigned to one of two treatment groups: One (dewormed, D) was dewormed with an oral anthelmintic paste (Equest Pramox) after the first evaluation period, and the other (not dewormed, ND) was not dewormed. Fecal egg counts in both groups (D and ND) were over 6,000 cyathostome eggs per gram (EPG) of feces initially. Two 5-day digestion trials were performed: a baseline test before deworming D and the second one 35 days after deworming. Blood samples were collected by venipuncture in both trials for hematocrit, hemoglobin (HGB), leukocytes, lymphocytes, eosinophils, and monocytes. Deworming resulted in 0 EPG in D throughout the experimental period, whereas ND mares continued to be heavily parasitized (EPG $>$ 5,000). Apparent digestion of nutrients, blood parameters, weight gain, and body condition score (BCS) did not differ ($P > .05$) between groups after deworming, although both groups gained weight ($P \leq .05$) and had higher ($P \leq .05$) BCS and blood HGB after deworming. Elimination of cyathostome infestation did not significantly alter the indices evaluated when the horses were fed a ration that met or exceeded nutrient requirements.

1. Introduction

In horses, intestinal parasites have been commonly cited as a cause of chronic weight loss [1–3], supposedly due to damage in the intestine and prevention of absorption of nutrients. *Strongylus vulgaris* larvae have been documented to cause thromboemboli that result in focal devitalization of the colonic mucosa [2]. The resultant scarring has been hypothesized to reduce the absorptive capacity of the large intestine in aged horses [1–3]. Horses fed primarily forage rations can obtain over 60% of their energy requirements from the absorption and utilization of volatile fatty acids produced by fermentation in the large colons [4]; therefore, reduction of absorption from this region of the intestinal tract could be significant to the overall energy balance and well-being.

In the 1970s and 1980s, new anthelmintic drug classes became available and routine rotation between drug classes became a common practice. As a result *S. vulgaris* has been virtually eliminated in many regions of the world [1,5,6]. But, unfortunately, other common species such as cyathostomes (small strongyles) have developed

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http://dx.doi.org/10.1016/j.jevs.2015.10.001

resistance to many, if not most, of the commonly used anthelmintics [4,6] and have become more prevalent. Although generally recognized as being less pathogenic than *S. vulgaris*, heavy infections with cyathostomes are still cited as causing malnutrition, weight loss, and poor health [1,5,6]. To the authors' knowledge, there are no controlled, scientific studies documenting the effect of heavy intestinal parasitism with cyathostomes on digestion and well-being in horses.

This study was designed to test the hypothesis that horses with large natural infections of intestinal parasites would have higher weight gain, body condition score, and better retention of nutrients after deworming than parasitized horses that were not dewormed but maintained under the same conditions and rations for 35 days after treatment. In addition, it was hypothesized that the parasitized horses would have lower hematocrits (anemia) and higher lymphocytes counts (reflecting inflammation) than the dewormed horses at the second evaluation. The objectives to test this hypothesis were to assess body condition and body weight, apparent digestion of nutrients, and complete blood counts in heavily parasitized mares before and 35 days after deworming relative to nondewormed controls.

2. Materials and Methods

The experimental protocol was approved by the Committee for Ethics and Use of Animals—at the Federal University of Minas Gerais (UFMG), Brazil—protocol #151/2013.

The experiment was performed at Haras Catuni, Montes Claros, Minas Gerais, Brazil. Twenty Mangalarga Marchador mares in the first third of pregnancy that had not been dewormed in the 12 months before experiment were selected on the basis of having high positive fecal egg counts (eggs per gram [EPG]) [7] in feces collected by rectal grab 3 weeks and again 1 week before the start of the experiment. At the start of the experiment, the mares were divided into two groups of 10 animals, paired according to weight and body condition score (BCS, scale of 1–5 [8], evaluated by Dr Rezende). The horses were assigned to be dewormed (D) or not dewormed group (ND) by pairing them according to body weight and body condition then randomly selecting one member of each pair to be in group D and the other being allocated to group ND to insure equivalence of the groups at the start of the trial. The age of the mares ranged between 3 and 8 years with an average weight of 397 $\pm$ 31 kg. At the start of the experimental period, the average BCS was 3. However, the mares all had been in BCS <3 when initially assessed and selected for the study 4 weeks before the start of the experiment. At that time, they were all moved to a new pasture (see below) and started on a regimen of corn-based grain concentrate feeding: 81% corn, 14% soybean meal, 3% limestone, and 2% mineral salt (Coequi Plus Tortuga, Mairinque, São Paulo, Brazil 18,120-000). By the time the study was started, they had all gained in weight and BCS. The individual mares were identified by the researchers by their unique markings, coat colors, conformation, and names given by the owner and fed their grain rations individually.

Before starting the experiment, all the mares were bathed with a solution (deltamethrin 25 g/L [Butox]) against ticks. Throughout the experimental period, they were kept as a single herd on 12.82 ha (GPS Etrex Vista Garmin) grass pasture seeded with *Panicum maximum* cv. Tanzania. Every day throughout the experiment at 07:00 hours the mares were herded into individual run in stalls located 2 km from the pasture and fed a corn-based concentrate. The concentrate was formulated to meet the nutritional requirements [4] for mares in the first third of pregnancy when fed with the pasture grasses, assuming a dry matter (DM) pasture intake of 2.0%. It was offered at a rate of 0.3% to 0.5% body weight (BW), depending on BCS. Mares with BCS >3 received 0.3% BW of concentrate while mares with BCS <3 received 0.5% BW of concentrate. Animals with BCS $= 3$ received 0.4% BW of concentrate. Because the mares had been paired based on BW and BCS, average intakes were equivalent in the two groups. Water and mineral salt (Coequi Plus Tortuga, Mairinque, São Paulo, Brazil 18,120-000) were provided free choice in the pasture. The amount of mineral salt in the pasture feeder was weighed weekly to estimate intake. The average individual consumption was 90 g of the salt per day throughout the experimental period.

Two digestion trials were performed. The first one was done before deworming to establish the baseline apparent digestion for each animal. At the end of the first digestion trial, the mares of group D received oral dewormer (Equest Pramox [moxidectin 0.4 mg/kg BW + praziquantel 2.5 mg/kg BW]). Animals in group ND did not receive dewormer, serving as a control group. Thirty-five days after deworming of group D, the second digestion trial was performed. In both trials, the assessment of digestibility was done by indirect method using an external indicator, purified and enriched lignin (LIPE, international patent PI0304136-9) [9,10], which was provided orally for 7 consecutive days in the morning concentrate ration. The first 2 days were for adaptation to the indicator. Fecal samples for evaluation of nutrients and LIPE were collected manually from the rectum or, if a mare was observed to defecate while waiting to go through the chute for rectal collection, from the freshly voided fecal pile every morning in the last 5 days of the digestion trial period [9]. After collection, the fecal samples were placed in polyethylene bags, identified with animal ID and day, and stored at -5°C within 1 hour of collection. At the end of the trial, the samples corresponding to the total 5 day collection of each animal were thawed and mixed for subsampling. Subsamples of 400 g were then frozen at -5°C pending laboratory analysis. These techniques are the same as used in other equine studies in this region [11,12].

Representative pasture grass samples were collected during each digestion trial in a pattern simulating the grazing habits of horses [13]. These samples were stored frozen and sent to the Animal Nutrition Laboratory of the Veterinary School of UFMG for chemical analysis. The nutrient composition of the total ration was calculated assuming the forage-to-concentrate ratio of 80:20. The ration composition and nutrient content was similar in both digestion trials (Table 1). The amount of concentrate fed during the digestion trials was fixed at 0.5% BW to reduce variability.

Fecal samples were collected directly from the rectum from all mares for determination of EPG [7] at the