

Chapter 3. Dietary Starch and Sugar Versus Fat and Fiber: Growth and Development of Foals I.

ABSTRACT

Growth and development of foals were examined in terms of body weight and body condition score, wither and hip heights, lengths of body, forearm and cannon bones, girth and circumferences of the physis and fetlocks. The experimental plan included two dietary groups of mares with foals maintained on pasture and supplemented with either a corn and molasses based sweet feed (SS), or a corn oil and fiber supplement (FF). Body weight and body condition scores were similar for both groups from birth until the following March when both declined in the SS group; when later switched to the FF diet, the SS group compensated in weight and condition.

Key Words: Rapidly Fermentable Carbohydrate, Fat, Fiber, Growth.

Introduction

Rapidly fermentable carbohydrate has been implicated as an etiologic factor in colic, laminitis and developmental orthopedic disease (Sprouse et al., 1987; Clarke et al., 1990; Williams and Pugh, 1993). Rapidly fermentable carbohydrate may become excessive when rapidly growing pastures are supplemented with concentrates rich in starch and sugar. The objectives were to compare growth and bone development of foals fed pasture and supplements rich in starch and sugar or in fat and fiber.

Materials and Methods

Thoroughbred mares with foals were kept on bluegrass clover pasture at the Virginia Tech Middleburg Agricultural Research and Extension (MARE) Center and supplemented with either a corn and molasses based concentrate high in starch and sugar (SS), or a corn oil and fiber supplement high in fat and fiber (FF). *Ad libitum* access to a mixed grass legume hay was provided in the winter months, and plain white salt was provided free choice throughout the year. The concentrates (Table 3.1) were isoenergetic and isonitrogenous, with mineral contents balanced to meet or exceed NRC requirements (NRC, 1989). Anthelmintic, vaccination, and hoof trimming schedules routine to the Virginia Tech MARE Center were followed (Ley et al., 1992).

The mares and foals were fed in pans on the ground so that both had access to the supplement. The foals were weaned between 5 to 7 months of age and maintained on their respective diets. The supplements were fed in varying amounts with goals of a 1:2 supplement:forage ratio and body condition scores maintained between 5 and 6.

Ten foals per group were studied in 1994 and 1995. Growth rates were measured monthly by body weight, body condition score, wither and hip heights, lengths of body, forearm and cannon bones, girth, and circumferences of the physis and fetlocks. Body weight was measured using an electronic scale (Model TC-10S, TYREL Corp.), and body condition was scored using the method developed by Henneke et al. (1983). Measurements are further defined as follows:

Wither Height: the distance from the ground to the highest point of the withers.

Hip Height: the distance from the ground to the highest point of the croup.

Body Length: the distance from the point of the shoulder to the point of the buttock.

Girth: the circumference of the girth behind the elbow and over the highest point of the withers.

Forearm: the distance from the point of the elbow to the accessory carpal bone.

Front Cannon: the distance from the accessory carpal bone to the proximal sesamoids.

Hind Cannon: the distance from the point of the hock (calcaneus) to the proximal sesamoids.

Physis: the circumference of the knee at the metaphysis of the distal radius, just above the accessory carpal bone.

Fetlock: the circumference of the fetlock at the metaphysis of the distal third metacarpal bone, just above the proximal sesamoids.

All measurements and body condition scoring were completed by the same individual in order to minimize error.

Body weights, conditions and measurement data were summarized as least squares means and standard errors and plotted over time. Analysis of variance was used to evaluate effects of diets, sampling times and their interaction (SAS, 1988). Regression equations to describe growth rates over time were fit using a graphics program (SlideWrite, 1995).

Results

The mean foaling dates and body weights of the mares after foaling, birth weights and sex of the foals are shown in Table 3.2. Body weight (Figure 3.1) and body condition scores (Figure 3.2) were similar in both groups of 1994 foals from birth until the following March (10 to 12 mo of age) when both declined in the SS group. The SS group remained behind the FF group in weight and condition from March through June, at which point the SS group was switched to the FF diet and examined for compensatory growth. The FF group remained on their diet during this time. Within a month of the dietary change, the SS group began to gain weight, and eventually condition. By October, the two groups were the same in weight and condition.

Wither and hip heights, lengths of body, forearm and cannon bones, girth, and circumferences of the physis and fetlocks were similar for both groups (Figures 3.3, 3.4, 3.5 and 3.6). Girth circumference data reflect the changes in weight and condition in both groups, however, overall frame size was not influenced by the loss of weight and condition apparent in the SS group.

Shedding of the winter coat occurred approximately 3 to 4 weeks later for the yearlings on the SS diet, as compared to the FF diet. The FF yearlings maintained hair coats superior to those of the SS yearlings throughout the spring and summer months.

Discussion

The growth rates noted in this study were similar to the weight and frame size data reported by Thompson (1995) and to those reported by Hintz et al. (1979). The rate of weight gain in the present study, compared to data from Ott and Asquith (1986), was lower than their yearling horses given *ad libitum* access to their concentrate and higher than their horses with restricted access. In another study, higher planes of nutrition increased body weight gains and long bone growth (Thompson et al., 1988).

The loss of weight and condition evident in the SS group (Figure 3.1) coincided directly with the appearance of spring pasture growth. Observations during this time indicated that both groups of horses were consuming the young growing pasture in preference to the hay offered. The differences in weight and condition during this time may have been due to a more rapid rate of passage and an excess of rapidly fermentable carbohydrate, occurring when the SS concentrate was consumed in combination with the young forage. We suggest that the FF concentrate afforded some protection against the high sugar and low fiber content of spring pasture.

Previous research at the Virginia Tech MARE Center indicated that supplementation of pasture is necessary to provide adequate amounts of vitamin A, phosphorus, selenium, copper and zinc throughout the year (Griewe-Crandell et al., 1995; Hoffman et al., 1995). The present study shows the value of fat and fiber supplementation, especially during rapid pasture growth.

Table 3.1. Nutrient profile of the supplements and pasture fed to mares during gestation and lactation. Data are summarized as fed^a for supplements and on a dry matter basis as a 90% confidence interval for pasture.

Nutrient	SS	FF	Pastures (n = 20)
DE, Mcal/kg	3.00	2.98	1.39 – 4.70
CP, %	14.6	15.3	12.5 – 24.4
ADF, %	7.2	22.8	24.7–35.5
NDF, %	12.6	34.0	not analyzed
Fat, %	2.3	12.2	not analyzed
NSC, %	63	25	not analyzed
Ca, %	.93	.95	.26–.65
P, %	.57	.56	.23–.36
Fe, mg/kg	150	150	89–524
Zn, mg/kg	192	192	17.7–31.4
Cu, mg/kg	60	60	6.1–13.8
Mn, mg/kg	192	192	34.4–98.6
Se, mg/kg	.6	.6	< .08
I, mg/kg	.6	.6	< .08

^aCalculated using NRC (1989) tables.

Table 3.2. Average foaling date, weights of the mares after foaling, birth weight and sex of the 1994 foals (mean \pm SE).

Supplement	Average Foaling Date	Mare Weight, kg	Foal Weight, kg	Sex
SS	05/06/94	541 \pm 15	53 \pm 1.1	7 colts:3 fillies
FF	04/26/94	535 \pm 18	52 \pm 2.5	4 colts:6 fillies

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