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Director's Digest

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UTILIZATION OF FAT-SUPPLEMENTED DIETS BY HORSES

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In order to achieve maximal production or performance from many horses, feeding energy-dense diets is required. Further, equine athletes require specific approaches to feeding management and training to achieve maximum, sustained high-intensity performances. Because of obvious caloric and some extracaloric benefits there is a lot of interest currently in the horse industry and the feed industry in the use of fat in high-energy diets for horses. Results in this laboratory over the last 7 years has focused on determining the efficacy of feeding fat-supplemented diets to various classes of horses.

Broodmares

Davison et al. (1991) fed broodmares a concentrated or fat-supplemented diet (5%) during late gestation and early lactation. Concentrate diets were formulated to contain similar nutrient:calorie ratios and were fed with bermudagrass hay in amounts to maintain constant body composition. Mares fed the fat-supplemented diet consumed 12% less feed than those fed the control diet during the last trimester of gestation, but both groups consumed similar amounts of feed during lactation. Adding fat to the diet had no detrimental effects on digestibility of any constituent of the diet and did not reduce mineral absorption. Feeding the fat-supplemented diet to the mares did not affect plasma glucose or lipid concentrations in the mares or plasma glucose concentrations in the foals. However, feeding the fat-supplemented diet to the mares increased the fat content of their milk and the plasma lipid concentrations in their foals. Foals from mares fed the fat-supplemented diets grew faster initially and were fatter than foals from mares fed the control diet. There was a trend for mares fed the fat-supplemented diet to return to estrus sooner following parturition, and they required fewer breeding cycles per pregnancy than mares fed the control diet. These results revealed obvious caloric efficacy of the fat-supplemented diet, and there may be extracaloric benefits to feeding fat to broodmares.

Growing Horses

Davison et al. (1991) compared growth, nutrient utilization, bone density and plasma hormone concentrations in weanling Quarter Horses fed a control or fat-supplemented diet. Concentrates were formulated to contain similar nutrient:calorie ratios and were fed in a 70:30 ratio with bermudagrass hay to appetite. The fat-supplemented concentrate contained 10% rendered animal fat. Weanlings in both groups consumed similar amounts of feed (2.6% of body weight daily), and the weanlings fed the fat-supplemented diet gained more weight than those fed the control diet. Also, girth gain and the efficiency of feed utilization was greater in weanlings fed the fat-supplemented diet. Digestibility of neutral detergent fiber was actually higher in the weanlings fed the fat-supplemented diet, apparently due to removal of some of the suppressing effects of carbohydrates on fiber fermentation in the large intestine. Bone density was not affected by feeding the fat-supplemented diet. Plasma glucose and insulin concentrations tended to be lower in weanlings fed the fat-supplemented diet, but plasma concentrations of the thyroid hormones were similar between diet treatment groups.

Scott et al. (1989) compared growth, nutrient utilization, bone density and plasma concentrations of lipids, glucose and insulin in yearling Quarter Horses fed a control diet or diets containing 5 or 10% rendered animal fat. Yearlings fed the 10% fat-supplemented diet grew faster and were more efficient in the utilization of feed in the first month of the experiment, but differences were minimized over the course of the 112-day trial. Digestibility of energy, ether extract and fiber were highest in those yearling fed the 10% fat-supplemented diet. There were no treatment differences in plasma lipid, glucose or insulin concentrations, and bone density was similar and normal for all horses on the study.

Data from these studies indicate a caloric efficacy of feeding fat to growing horses, and adding fat to provide 18-20% of digestible calories may remove some of the proposed deleterious effects of feeding high carbohydrate diets to young growing horses.

The Equine Athlete

The most dramatic effects of feeding fat to horses in this research program have been in the high-performance, athletic horse. Initially, Meyers et al. (1989) fed mature Quarter Horses a control and fat-supplemented diets containing 5% and 10% rendered animal fat. Each horse received each diet, and after 3 weeks of adaptation to the diets the horses were given a standardized exercise test (SET) in an equine treadmill at an aerobic level of work. During the adaptation period the horses were fed to constant body weight and composition. When the horses were fed the 10% fat-supplemented diet, they required 25% less concentrate feed than when fed the control diet. This was an obvious caloric effect of adding fat to the diet. However, there were extracaloric benefits to feeding the fat-supplemented diets. Muscle glycogen concentrations at the onset of the SET were 52% higher when the horses were fed the 10% fat-supplemented diet than when they were fed the control diet. This observation was an important finding because it indicated that providing some of the calories to exercising horses in the form of fat may spare glycogen reserves during normal, aerobic work that could be used for energy production when horses reach a state of anaerobiosis during acute, high-intensity exercise.

The theory that feeding fat might improve glycogen sparing and sustain high-velocity exercise was tested in two subsequent experiments. Webb et al. (1987) reported that feeding the 10% fat-supplemented diet increased effort and stamina in the cutting horse. Cutting horses were adapted to the fat-supplemented diet for three weeks and subjected to an SET on a "mechanical cow." When cutting horses were fed the fat-supplemented they executed significantly more hind-quarter turns during the SET than when they were fed the control diet--a reflection of differences in effort and stamina. In a very dramatic experiment, Oldham et al. (1990) fed 6 mature horses a control and 10% fat-supplemented diet, galloped the horses in simulated race training on each diet for three weeks, and subjected them to an intense SET consisting of four, 600-m runs with 5 minutes of rest between runs. Muscle biopsies were obtained before and after the SET. As before, feeding the fat-supplemented diet resulted in higher muscle glycogen concentrations, and the horses ran faster at a constant heat rate than when they were fed the control diet, particularly in the last two runs. Data from these experiments indicate that there are extracaloric benefits to feeding the fat-supplemented diet to intensely-exercising horses that is related to glycogen sparing during aerobic work and subsequently increased anaerobic energy production at the end of exhaustive exercise bouts.

Another area of research in this laboratory focuses on thermal regulation in the equine athlete. It has been demonstrated that body fat content affects the energy requirement for thermal regulation (Webb et al., 1990) and it was suspected that composition of the diet may be a factor in the total thermal load on exercising horses. Thus, Potter et al. (1990) galloped mature horses in both hot weather and temperate weather, and during both seasons fed the horses to achieve lean or fat body conditions. Further, in each season and in each body condition the horses were fed a control and a 10% fat-supplemented diet. During both seasons, digestible energy requirements for thermal regulation were reduced both by lowering body fat content and by feeding the fat-supplemented diet. Thus, it appeared that for the best interest of the animal, equine athletes should be maintained in lean body condition. However, there was a concern as to whether feeding equine athletes to too lean body condition might cause catabolism of muscle glycogen reserves. Therefore, Scott et al. (1992) and Jones et al. (1991) conducted two studies with Thoroughbred and Miniature Horses, respectively, to determine the interaction between body composition and diet composition on muscle glycogen storage and utilization. The Thoroughbred horses were galloped during diet adaptation and tested on a track, and the Miniature Horses were lounged during diet adaptation and tested in an equine treadmill. In both studies, when horses were fed the control diet and body fat content was reduced to its lowest level (slightly less than moderate flesh; typical of the condition of race horses) muscle glycogen concentrations were lower than when the horses were in fleshy condition. However, feeding the fat-supplemented diet prevented the loss of muscle glycogen in the horses when they were fed to a very lean body condition.

From these studies it appears that the 10% fat-supplemented diet is efficacisus for the equine athlete because it apparently (1) reduces total feed requirements, (2) reduces thermal load, (3) increases muscle glycogen concentrations and (4) improves performance. Further studies are underway at present to determine minimal adaptive time for these effects to occur.

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