Fat Adaptation And Exercise:  Less Heat Production and Water Loss, and an Improved Power:Weight Ratio

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A hay:oats:corn oil (45:45:10 by weight) diet compared with a hay and oats (50:50) diet produces approximately 1–2 Mcal less heat, approximately 4 L less fecal water, requires approximately 2 L less water for evaporation, and carries approximately 12 kg less bowel ballast (dead weight in the large bowel). All of these changes should improve athletic performance. Author’s address: Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0306. © 1997 AAEP.

1. Introduction
Ergogenic diets usually are designed to influence muscle fuels. Diet may also influence the power: weight ratio (fatness, wetness), thermoregulation (heat production, hydration), and mental attitude. In preparation for the Atlanta 3-day event, the equine committee asked the following question: Would dietary fat reduce heat production sufficiently to influence performance and to help ensure equine welfare? An advantage of 2.2 Mcal (9.24 MJ) less heat production was found in one experiment.2

2. Materials and Methods
A bioenergetic model was developed for three diets, i.e., hay (HAY), hay and oats (H&O, 50:50), and hay, oats, and corn oil (HOF, 45:45:10), providing a 500-kg horse with 36 Mcal of metabolizable energy per day, which is an average value for a top grade, 3-day event horse.3 The composition of ingredients was obtained from tables,4 and intake energy, digestible energy, metabolizable energy, net energy for maintenance, net energy for light work, and net energy for hard work were calculated by using typical efficiency factors.5 The net energy requirements for the four phases of the event on the second day of a top level, 3-day event were recalculated,6 and the corresponding amount of metabolizable energy, digestible energy, gross intake energy, and heat production were derived by the model. Similarly, net energy for light work during the rest of the day and for stall maintenance were calculated, and corresponding intake energies and heat production were derived from the model. Feed intake, fecal output, fecal water output, water for evaporation, and the prefecal mass (bowel ballast) were calculated. The heat of fermentation was also calculated.

3. Results
The model reveals that HAY is impractical and estimates that the relative advantages of HOF over H&O are 2% less heat during the event, 5% (1.2 Mcal, or ~5 MJ) less heat during the day, 12% (6 kg) lower water losses (sweat and feces), 22% less feed...

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intake, and 31% less fecal output and bowel ballast (dead weight of prefecal mass in the bowels).

The model indicated feed intakes of 17 and 13 kg/day dry matter (DM), and fecal outputs of 19 and 13 kg/day (wet weight, assuming 33% DM), for the H&O and HOF diets, respectively. Assuming a mean retention time of 29 days and 20% DM, corresponding prefecal masses are estimated as 38 and 26 kg.

4. Discussion

The difference in heat production of 1.2 Mcal (~5 MJ) in the model is ~3%, and opinions have varied about its likely impact during competition. Some investigators have regarded it as trivial; others have regarded it as potentially important under hot and humid conditions.

The difference between 1.2 Mcal (~5 MJ) found in the model and 2.2 Mcal (9.24 MJ) in the previous experiment has two likely explanations (apart from errors): (a) fat adaptation may reduce the spontaneous activity and reactivity of a horse by up to 25%, and (b) if the horse is meal fed, efficiency of utilization for adenosine triphosphate synthesis is ~39% for fat and ~20% for carbohydrates.

The difference of 12 kg in bowel ballast represents a substantial power:weight advantage. This beneficial effect of fat supplementation has been largely overlooked by those who believe that dietary fiber may be helpful in maintaining a reservoir of water and electrolytes in the large bowel for use to replenish blood for losses in sweat. In the model, the difference between H&O and HOF is 12 kg of colonic contents, including 9.6 kg of water. Of this, 4.8 kg are needed for an obligatory fecal loss, and 4.8 kg remain available to replenish blood water, and these cancel, giving a zero net gain of body water. In addition, the HOF diet requires 2 kg/day less water for evaporation.

In other studies, fat supplementation has been shown to affect working muscles by increasing VO2 max, increasing fatty acid oxidation, sparing muscle glycogen during aerobic exercise, and increasing glycojenolysis during sprinting in horses. The bioenergetic model reveals that fat supplementation also reduces heat production, improves hydration, and, perhaps most importantly, diminishes bowel ballast and improves the power:weight ratio.

References