Weight Loss in Obese Dogs: Evaluation of a High-Protein, Low-Carbohydrate Diet\textsuperscript{1,2}

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\textbf{EXPANDED ABSTRACT}

\textbf{KEY WORDS:} • dog • obesity • high-protein diet • body composition

Obesity and excess body weight are estimated to affect approximately 25\% of dogs receiving veterinary care in Western countries (1,2). They are recognized as the most common nutritional diseases in companion animals (3). Energy restriction both during and after weight loss is the cornerstone to achieve and maintain optimal body condition. An important concern with energy restricted diet, however, is to cover all the requirements for essential nutrients, especially protein. In obese humans and animals, increasing dietary protein during weight loss programs has been shown to maintain lean body mass (4,5). The purpose of this study was therefore to assess the effect of a high-protein low-starch weight-reduction diet in the management of canine obesity.

In a preliminary study of client-owned dogs nine overweight or obese dogs (8 females and 1 male) with mean ages, body weights and body condition scores (BCS\textsuperscript{4}) of 8 y (range 3–10), 30 kg (13.5–48) and 4.6/5 (4.5–5 in a 5-point scale), respectively were recruited. Mean excess body weight was 30\% (11–58). History and clinical examination revealed inactivity or lethargy (n = 5), impaired breathing (n = 3) and locomotion problems (n = 2) but all other variables were within normal limits.

Treatment consisted of feeding a high-protein, low-starch diet at 40–55\% of maintenance energy requirements (MER) for the dog’s estimated optimal body weight until it reached optimum body condition. Dogs were fed twice daily and sessions of exercise of at least 20 min/d were recommended to prevent excess protein catabolism and to minimize losses of fat-free mass (FFM).

The time necessary to reach the target weight and a BCS of 3 ranged from 4 to 38 wk (mean ± SEM: 18.3 ± 3.8). The rate of weight loss varied from 0.8 to 3.1\% (1.9 ± 0.3) per wk. Weight loss improved or suppressed the inactivity, lethargy, impaired breathing and locomotion problems initially reported by the owners.

\textbf{MATERIALS AND METHODS}

\textbf{Experimental study}

\textit{Experimental diets.} Two high-fiber dry expanded diets were used: a high-protein and low-starch diet [Test,\textsuperscript{5} %DM: crude protein, 47.5\%; starch, 5.3\%; total dietary fiber (TDF), 30.8\%; ash, 7\%; and metabolizable energy (ME), 11.6 kJ/g as fed] formulated for the study and a commercially available control weight reduction diet (Control\textsuperscript{6}, %DM: crude protein, 23.8\%; starch, 23.9\%; TDF, 38.6\%; ash, 5.2\% and ME, 9.8 kJ/g as fed). Energy content was measured using dogs at the research center of Royal Canin.

\textit{Animals: feeding protocol.} Eight adult obese Beagle dogs, 4 neutered males and 4 intact females, 6 ± 0.4 (mean ± SEM) y of age at the beginning of the study, at least 30\% (30–72) overweight for at least 1 y, and belonging to the Animal Nutrition Unit of the Veterinary Faculty, were used. Optimal weight and thus target body

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\textsuperscript{4} Abbreviations used: BCS, body condition score; FFM, fat-free mass; ME, metabolizable energy, MER, maintenance energy requirements; TDF, total dietary fiber.

\textsuperscript{5} High-protein experimental diet. Ingredient list: poultry meal, corn gluten, rice gluten, purified cellulose, barley, beet pulp, poultry fat, poultry liver hydrolysate, minerals, psyllium seeds, brewer’s yeast, fructooligosaccharides, chelated trace elements, L-carnitine, vitamins.

\textsuperscript{6} Hill’s Prescription Diet, Canine R/D dry, Hill’s Pet Nutrition, Topeka, KS. Ingredient list: maize meal, peanut hulls, chicken and turkey meal, soy hulls, poultry hydrolysate, vegetable oil, linseeds, cellulose powder, salt, choline chloride, L-carnitine, zinc oxide, iron sulfate, manganese oxide, copper sulfate, calcium iodide, sodium selenite, vitamin A, pro-vitamin D, vitamin E, niacin, thiamin, pantothenic acid, pyridoxine hydrochloride, riboflavin, folic acid, biotin, vitamin B\textsubscript{12}, antioxidants.
weights for those dogs were known from historical colony data and corresponded to a BCS of 3 using a scale from 1 to 5. Obesity was also assessed by BCS using the same scale. Table 1 summarizes data about the dogs. Animals were assigned to the high-protein and control diets, respectively. The energy levels that induced weight loss were, respectively, 76.2% and 68.0% of energy dense diets than the baseline diet, the energy allowance was reduced by 10%. The same protocol was used with the group fed the control diet, with some adjustments, to ensure similar energy intake and pelvic circumferences (data not shown) were significantly correlated with excess body weight for both groups. The BCS was also significantly and positively correlated with thoracic and pelvic circumferences (P < 0.001; r ranging from 0.72 to 0.79).

**RESULTS**

**Weight loss**

Initial and target body weight and BCS are reported in Table 1. Body fat content was 37.3 ± 2.0% and 35.8 ± 1.3% for the high-protein (Test) and the control group, respectively. Mean body weight loss was 43.1 ± 2.8% of initial body weight (45.3 ± 5.3% vs. 40.8 ± 2.5% in high-protein and control group, respectively). A linear relationship was found between time and excess weight (r² = 0.98). The BCS and both thoracic and pelvic circumferences (data not shown) were significantly (P < 0.001; r ranging from 0.73 to 0.93) and positively correlated with excess body weight for both groups. The BCS was also significantly and positively correlated with thoracic and pelvic circumferences (P < 0.001; r ranging from 0.72 to 0.79).

**Composition of weight loss**

Body composition assessed by the deuterium oxide dilution method allowed calculation of the composition of the body weight loss. Total body weight loss was 6.3 ± 0.9 and 5.7 ± 0.4 kg and its fat content 80.4 ± 3.1% and 70.0 ± 3.1% (P = 0.056) for the high-protein and the control groups, respectively.

**Food consumption and energy allowance**

During the pretest period food consumption of the baseline commercial diet was 310 ± 13 and 296 ± 8 g d⁻¹ in dogs assigned to the high-protein and control diets, respectively. These amounts correspond to an energy allowance of 694 ± 13 kJ/kg target body weight (0.075) d⁻¹ and 659 ± 10 kJ/kg target body weight (0.075) d⁻¹. By feeding similar amounts of less energy dense diets than the baseline diet, the energy allowance was automatically reduced and weight loss was observed with both diets. The energy levels that induced weight loss were, respectively, 419 ± 19 and 374 ± 32 kJ/kg target body weight (0.075) d⁻¹ for the high-protein and the control group. These amounts correspond, respectively, to 76.2 and 68.0% of the MER for optimal body weight, on the assumption that 550
k] kg\(^{(0.75)}\) d\(^{-1}\) can be considered as an adequate equation to estimate MER in medium-sized adult dogs (8).

More severe food restriction was necessary to induce weight loss in female than in male dogs: 356 ± 24 (64.8% MER) vs. 437 ± 10 (79.4% MER) kJ/kg target body weight\(^{(0.75)}\) d\(^{-1}\) (P = 0.02), respectively. The level of energy that induced initial weight loss did not allow dogs of either sex to reach target weights. To reach target weight, energy allowance was gradually decreased to reach 66.2 ± 7.7% and 61.6 ± 5.2% MER for the high-protein and the control groups, respectively, and 74.0 ± 4.1% and 53.9 ± 2.5% MER (P = 0.006), respectively, for males and females.

**DISCUSSION**

In dogs most nutritional studies on obesity are conducted on recently induced excess weight by ad libitum feeding of a high-fat diet (9,10). By contrast, we chose to use chronically (>1 y) grossly obese Beagles, in the static phase of obesity (11), to be as close as possible to field conditions. In veterinary practices, as shown in our field study, weight loss programs are generally set up for overweight or obese dogs (BCS of 4 and 5) in the static phase of obesity. Additionally, in our two studies, the mean age of the dogs was similar to the age for peak prevalence of obesity in the canine species (2). At baseline and except for their weight, all the dogs were healthy as assessed by clinical, serum chemistry and hormonal evaluation.

Traditionally, high-fiber low-energy diets have been promoted for weight management. The content of TDF in those diets typically range from 20 to 40% on a DM basis, as in the two diets used in this study. Dietary fibers are used to dilute energy density of the food and to provide a feeling of satiety by causing gastric distension. This latter effect remains controversial in dogs. A concern with feeding weight-reduction diets is that reduced energy intake is associated with suboptimal intake of essential nutrients, especially protein (12). Feeding a high-protein diet in obese dogs resulted in a better conservation of lean body mass (4).

As expected, dogs of both groups lost their excess body weight and reached their predetermined target body weight over a period ranging from wk 12 to wk 26. Although the weight loss was more rapid in the control group than in the high-protein group, the differences were not significant between the diets for the duration (P = 0.11) nor for the rate of weight loss (P = 0.22).

Although the difference in the loss of lean body mass only approached significance (P = 0.056), and the test diet had a slower rate of weight loss than that of the control, the results tend to support the hypothesis that higher levels of dietary protein in weight-reduction diets for dogs result in a greater conservation of lean body mass. However, a slower rate of weight loss over a longer period with the control diet might have resulted in a better conservation of FFM. A larger study with more dogs needs to be performed to test this hypothesis.

During wk 2 of the study, the average energy allowance was decreased to reach 73.4% of the energy given at baseline. This was achieved by progressively replacing the baseline diet by both reducing diets. This level of energy restriction and the further 10% reduction during wk 3 induced weight loss in all 4 males but in only 2 out of 4 females. The energy restriction to maintain a 1–2% weekly weight loss rate had to be more severe in females than in males: 53.9 ± 2.5% vs. 74.0 ± 4.1%. These preliminary observations suggest that energy restriction could be more severe in females to induce and maintain weight loss. To our knowledge, this has not been reported previously, probably because others did not adjust energy intake to the rate of weight loss from the beginning of the study.

One common figure proposed to estimate energy allowance during a weight-loss program is 60% of MER for optimal body weight (13,14). Our data suggest that this degree of energy restriction might not be sufficient to induce and maintain weight loss in obese female dogs. This should be taken into account when setting up a weight-loss program.

In conclusion, in the experimental study, although rates of weight loss slightly differed between reducing diets, our data suggest that higher protein intake might reduce lean body mass losses. Energy restriction should be higher in female dogs and validated over time to ensure regular weight loss. From our field study, it appears that our test diet allowed safe and efficient weight loss.

**LITERATURE CITED**