A Comparison of the Nutritional Adequacy of Home-Prepared and Commercial Diets for Dogs

Erin L. Streiff, Bettina Zwischenberger, Richard F. Butterwick, Elisabeth Wagner, Christine Iben, and John E. Bauer

Author Affiliations

To whom correspondence should be addressed. E-mail: jbauer@cvm.tamu.edu.

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EXPANDED ABSTRACT

Maintaining the health of dogs and cats by feeding wholesome nutritional diets is an important component of responsible pet ownership. Numerous improvements in companion animal nutrition have resulted in a wide array of foods providing complete and balanced nutrition. In spite of these developments, some pet owners prefer preparing food at home for their animals (1). Although owners generally have good intentions, some of them may lack the scientific knowledge or other resources to recognize important nutritional needs of their pets. Thus the potential for nutrient deficiencies, excesses and imbalances exists.

This study was conducted to compare the nutritional adequacy of home-prepared diets in young and adult dogs using data gathered from a population of dogs and their owners in Vienna, Austria. Representative samples of home-prepared diets were analyzed and compared to commercial pet foods and to recommendations set by the American Association of Feed Control Officials (AAFCO) (2).

MATERIALS AND METHODS

Both young and adult animals were studied with participants selected based on owners’ responses to an animal ownership questionnaire. The animal use protocol was approved by the University of Veterinary Medicine Clinical Department and written informed consent from owners was obtained. Young (<1 y) and adult (1–7 y) dogs were recruited and divided into commercial diet (CD) or home-prepared diet (HPD) fed groups. The HPD group included dogs fed diets based on the owner-selected use of table scraps and more carefully prepared recipes using human-grade foodstuffs. No nutritional advice was given to any pet owner as to diet preparation. The CD group comprised only those animals fed commercially available complete and balanced diets. Dogs fed >15% commercially manufactured complete and balanced diets (dry matter basis) mixed with home-prepared foods were excluded from the HPD group. Seven-day weighed food records, subsamples of daily feedings during a consecutive 7–d period, and serum samples collected after a 30–d period of feeding the respective diets were analyzed. The subsamples of the 1–wk feeding period were pooled, lyophilized and analyzed by a commercial laboratory (Waltham Center for Pet Nutrition, Leicestershire, UK). Vitamin D contents were estimated based on the 7-d food diaries. Values were compared with AAFCO recommendations. Fatty acid profiles of the total dietary fat in these samples were performed (3) and compared with representative commercial European and American pet food products of both the canned and dry extruded varieties. Samples of the actual CD fed were unavailable for analysis. The CD analyzed were thus selected based on brands actually fed by the owners (Austria) and popularity (United States). Fatty acid analyses of serum phospholipid fractions of dogs fed the HPD were performed (4) and compared to those of dogs fed dry extruded American pet foods.

Diet and serum data from four groups were analyzed and compared using two-way ANOVA. When significant differences were found, the means were compared using the Bonferroni method of multiple comparisons. When data were available for only the adult and young dog HPD groups these data were compared using two-way ANOVA.
sample t-tests. Chi-square tests for goodness of fit were used to compare diet compositions to those recommended by AAFCO. Results were considered significant at $P < 0.05$.

RESULTS

A total of 96 dogs were recruited, although complete data were available on only 79 dogs.

There were no differences in dietary energy or % fat among any of the diets but all diets had mean values at least 10% greater than AAFCO-recommended values (Table 1). The dogs generally had optimal body condition scores (BCS) of 3 to 3.5 using a 5-point scale, with 3 being optimal and 5 obese. Among 88 dogs examined, only seven (8%) had a BCS above the ideal score of 3 to 3.5 (five in the HPD group and two in the CD group). Average diet protein concentrations were significantly higher in HPD than in CD. The HPD were significantly lower in fat-soluble vitamins A, D and E. The only exception to these findings was that the Ca:P ratio and vitamin D contents of the young dog HPD were not different compared to those of young dog CD. All serum chemistry profiles and complete blood counts were within normal limits for young dogs and adults in both the HPD and CD groups (data not shown). Differences between the young and adult animals were unremarkable and typically those ascribed to growth and development.

To assess nutritional adequacy, the diets were compared to AAFCO recommendations using the chi-square test for goodness of fit. Each nutrient (dry matter basis) was determined to be either above or below the appropriate AAFCO recommendation, and chi-square analysis was performed. In the HPD, energy, fat and protein were above AAFCO recommendations, whereas calcium, Ca:P ratio and vitamins A and E were below recommendations (Table 1). Trace-mineral analysis of the HPD revealed that potassium, copper and zinc concentrations were below AAFCO recommendations, whereas magnesium, manganese, iron and sodium exceeded AAFCO minima (Table 2). In the CD, all variables except for the Ca:P ratio were significantly above AAFCO recommendations (Table 1).

Individual mean essential amino acid contents of the HPD, as % DM, were higher than AAFCO values for both adult and young dogs and no significant differences between adult and young dogs for any of the amino acids were found (data not shown). The amino acid with mean nearest its AAFCO recommendation was tryptophan in the young dog diets; however, its concentration was still >50% greater than the AAFCO recommendation (0.34 vs. 0.20%).

Dietary essential fatty acid (EFA) contents of the HPD exceeded AAFCO recommendations (Fig. 1) as did the CD and other dry diets studied (data not shown). On an energy basis, the HPD were significantly higher in mean total saturated fat and lower in mean total polyunsaturated fat compared to those of a group of American and Austrian commercial dry extruded type diets. However, saturated and polyunsaturated fatty acids (PUFA) were not different from canned types from both countries. Relative fatty acid contents of serum phospholipid fractions of HPD-fed dogs were significantly lower in 18:2(n-6) and 20:4(n-6) than those from a population of 37 normal dogs presented to the nutrition laboratory at...
Texas A&M University (Fig. 2). These latter dogs had been fed one of three American commercial dry extruded type diets from the group of diets reported in Figure 1. Ten out of 35 HPD dogs' serum triacylglycerol fractions contained no detectable 18:3(n-3), even though all home-prepared diets contained this fatty acid. Seven of these animals had been fed diets containing the higher amounts of 18:3(n-3) among those analyzed (data not shown).

**FIGURE 1**
Fatty acid contents of the 35 home-prepared diets (HPD: all HPD, n = 35; young adult HPD, n = 8; adult HPD, n = 27), European extruded diets (EC dry, n = 3), American extruded diets (US dry, n = 6), and European plus American canned diets (EC/US can, n = 6) in % energy as fat. (A) 18:2(n-6) (white bars) and 18:3(n-3) (black bars) fatty acids; AAFCO minimum for 18:2(n-6) indicated by dotted line. (B) Total saturated (white bars), monounsaturated (black bars) and polyunsaturated (cross-hatched bars) fatty acid content in % energy as fat; AAFCO total fat minima for growth (solid line) and maintenance (dotted line) are indicated. Bars marked by "a": HPD saturated fat significantly different vs. EC dry and US dry diets, P < 0.05. Bars marked by "b": HPD polyunsaturated fat amount significantly different vs. EC dry and US dry diets, P < 0.05.

**FIGURE 2**
Plasma phospholipid 18:2(n-6) and 20:4(n-6) contents in relative weight percentage of dogs fed HPD (n = 35) and three commercial dry extruded-type diets of U.S. manufacture (Diet A, n = 19; Diet B, n = 10; Diet C, n = 8). Bars with no letters in common are significantly different (P < 0.05).

**DISCUSSION**
Dietary energy and macronutrient levels were above AAFCO recommendations, Energy density did not differ among the four diets. The Ca:P ratio in the adult and young dog HPD was lower than that in the respective CD. Vitamin D in adult HPD was significantly lower compared with that in CD, although not significantly different from AAFCO recommendations. These three nutrients are critical in reaching and maintaining maximal bone density throughout life (6). The fact that none of the dogs showed clinical signs of rickets or osteomalacia lends support for the present AAFCO minimum values for these nutrients, even though the CD were significantly different from the HPD in this study. By comparison, other fat-soluble vitamins in many of the HPD were below AAFCO recommendations and would likely require supplementation for improved nutrition.

Although all diets were adequate in EFA, the HPD had a wide range of total fat and contained more saturated fatty acids and fewer polyunsaturated fats than those in samples of dry extruded commercial diets. The HPD were more similar in this regard compared with canned diets. This difference may have been attributable to the likelihood that table foods are generally more similar in fat content as source materials used in canned diet production.

It is of interest that serum phospholipid fractions of dogs fed the HPD contained lower 18:2(n-6) and 20:4(n-6) fatty acids compared to those of dogs fed one of three dry, extruded diets. This finding is not unexpected because the commercial dry diets analyzed contained more PUFA on average than did the HPD. Another finding of interest was that in some of the HPD-fed dogs serum triacylglycerol fractions contained no detectable α-linolenic acid, even though the diets contained this fatty acid. This finding and the lower serum phospholipid 18:2(n-6)
and 20:4(n–6) together with low dietary vitamin E concentrations in the HPD may be indicative of increased PUFA peroxidation and possible vitamin E depletion. This possibility was not directly examined because serum vitamin E levels were not measured. An additional explanation is that beta-oxidation of dietary α-linolenic acid may have occurred. This fatty acid is generally poorly converted to longer carbon chain (n–3) fatty acids (7,8). Consistent with this latter possibility are the low relative amounts of long-chain (n–3) PUFA in the serum phospholipid fractions, even though in the case of one of the commercial diets fed for this comparison high amounts of α-linolenic acid were present.

Purported risks associated with feeding HPD include the consumption of high energy density diets without increased nutrient density. However, the present study found that both HPD and CD were not different in energy content. In spite of energy content similarities, potential nutritional concerns with HPD were that some macrominerals, fat-soluble vitamins, including antioxidants, and trace minerals, potassium, copper and zinc were below AAFCO recommendations. Thus, these nutrients should be carefully evaluated when considering feeding HPD. Although clinical signs of deficiency were not found in dogs fed the HPD, a sufficient margin of safety above absolute physiological requirements is reflected in the AAFCO values. Also, the study period lasted only 30 d and overt deficiency signs may take longer to develop. It is unknown whether owners had fed home-prepared diets with similar nutrient composition before enrolling their dogs in the study but that is likely the case. However, some individuals may have improved their dog’s nutritional status with the knowledge that their efforts were being documented. In any case no overt nutritional deficiencies were observed. Certain nutrients in HPD analyzed in this investigation were clearly below any case of safety above absolute physiological requirements is reflected in the AAFCO requirements of Dogs

Footnotes

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3 Abbreviations used: AAFCO, American Association of Feed Control Officials; CD, commercial diets; HPD, home–prepared diets; PTH, parathyroid hormone.

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