Interactions of Cellulose Content and Diet Composition with Food Intake and Digestibility in Dogs

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EXPANDED ABSTRACT

KEY WORDS: dogs • satiation • fiber • dry matter intake

In diets specifically designed for obese dogs and cats, fiber is considered important to reduce energy density and therefore energy intake. However, there is contradictory evidence on the effects of high fiber diets on food intake. Butterwick and Markwell (1997) found no influence of soluble or insoluble fiber on the energy intake in energy-restricted dogs. In contrast, Jewell and Toll (1995) noted decreased energy and dry matter intake in dogs after they were fed a medium or high fiber diet. These differences may be due to different composition or palatability of basic experimental diets. In this investigation, we studied the interactions between diet composition (especially high fat content) and fiber (cellulose) on dry matter intake. Digestibility of macronutrients and organic matter was also determined in some high fiber diets.

Materials and methods. Eight adult, healthy Beagles (males and females, mean body weight 14.1 kg; range 12.0–18.6 kg) were fed three different diets (MLF, meat low fat; MHF, meat high fat; CLF, chicken meal low fat; Table 1). In each of the three trials, the respective diet was offered in an amount that equaled 120% of the dogs' maintenance energy requirements. The latter were determined by recording the dogs' body weights and energy intake for 3 mo before the start of the trial. The data for individual dogs varied from 0.43 to 0.67 MJ digestible energy/kg body weight0.75.

The fiber content (crude fiber) of the diets was increased by 2.7% in dry matter every 2 db by adding cellulose to the diet (thoroughly mixed with the food) until the dogs reduced their energy intake to 100% of their maintenance requirements. This was considered to be the limiting fiber content for the intake of the high fiber diet. Digestion trials were carried out on diets CLF and MHF at the limiting fiber content (3 d adaptation, 1 wk feces collection) by marker method (chromic oxide 0.25% dry matter, Petry and Rapp 1971). An additional 1-d experiment was carried out for diets MHF and CLF with the limiting level of fiber as follows: an additional meal of the same diet without cellulose was given 2 h after the dogs had been offered the high fiber diet and had eaten an amount of energy equaling their maintenance requirements. The energy content of the additional meal amounted to the maintenance energy requirements; thus the dogs were offered 220% of their maintenance requirements (i.e., 120% as a high fiber diet with the limiting fiber content and then 100% as the basal diet without added fiber). Crude nutrients were determined according to the method of Weende, fiber by crude fiber analysis. Statistical analysis included regression analysis; data are expressed as means ± sd, and means were compared by one-way ANOVA and Tukey's test. Significance was indicated by P < 0.05.

Results. The limiting fiber level in the diets achieved by adding cellulose, i.e., the content of cellulose that led to a decreased intake of energy, was very high in all three diets. In the high fat diet, MHF, more fiber was tolerated than in the other two diets [41.8 vs. 30.8 and 31.9 g/(kg body weight · d), respectively; Table 2] but there were no significant differences among the groups due to the high variation. The dry matter intake at the limiting fiber level was not different in all three diets (Table 2). When a cellulose-free meal was offered after...
the high fiber diet, all dogs ate the additional meal of cellulose-free diet in less than 30 min and therefore dramatically increased their intake of dry matter and energy. Their dry matter intake was 47.7 ± 7.9 g/(kg body weight) in the MHF diet and 53.4 ± 7.0 in the CLF diet. The energy intake for that day was twice maintenance requirements. This suggests that a high cellulose content affects food intake in dogs mainly by a decrease in palatability. A limiting effect of the dry matter intake with respect to fill was not obvious, because all dogs accepted an extra meal of a more palatable, cellulose-free diet shortly after eating the diet with the limiting fiber content. The results of this trial are in agreement with those of Butterwick and Markwell (1997).

The digestibility of organic matter in the fiber-supplemented diets was reduced to between 45 and 63% although the non-fiber compounds of the experimental diets have been shown by various authors to be highly digestible (>90% digestibility of organic matter; Arndt 1986, Drochner 1975, Göcke 1970). There was a significant negative correlation between the fiber content in dry matter (26–45%) and the digestibility of organic matter (45–63%). However, the slope of the regression equation in these investigations with high fiber content [apparent digestibility of organic matter = 90.8 − 1.56 · crude fiber (% dry matter)] was less steep than that in the calculations of Earle et al. (1998), [apparent digestibility of organic matter = 90.8 − 1.56 · crude fiber (% dry matter)]. In the latter investigation, the fiber content was considerably lower than in this study. This suggests that the effect of fiber on digestibility is not as great in diets with very large amounts of fiber.

### LITERATURE CITED


### TABLE 2

Fiber content limiting food intake and dry matter intake in Beagles at the limiting cellulose level of the diet¹

<table>
<thead>
<tr>
<th></th>
<th>Crude fiber in dry matter</th>
<th>Dry matter intake at limiting cellulose level</th>
<th>Dry matter intake at highest cellulose level plus additional cellulose free meal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Without cellulose</td>
</tr>
<tr>
<td>Diet MLF</td>
<td>30.8 ± 6.2</td>
<td>26–42</td>
<td>18.5 ± 3.2</td>
</tr>
<tr>
<td>Diet MHF</td>
<td>41.8 ± 8.2</td>
<td>26–53</td>
<td>13.3 ± 2.3</td>
</tr>
<tr>
<td>Diet CLF</td>
<td>31.9 ± 6.1</td>
<td>26–45</td>
<td>19.6 ± 3.3</td>
</tr>
</tbody>
</table>

¹ n = 8.