The effects of dietary fibre type on satiety-related hormones and voluntary food intake in dogs

Guido Bosch1*, Adronie Verbrugghe2, Myriam Hesta2, Jens J. Holst3, Antonius F. B. van der Poel1, Geert P. J. Janssens2 and Wouter H. Hendriks1

1Animal Nutrition Group, Department of Animal Sciences, Wageningen University, PO Box 338, 6700 AH Wageningen, The Netherlands
2Laboratory of Animal Nutrition, Faculty of Veterinary Medicine, Ghent University, Heidestraat 19, B-9820 Merelbeke, Belgium
3Department of Biomedical Sciences, The Panum Institute, University of Copenhagen, Blegdamsvej 3, DK-2200 Copenhagen, Denmark

(Received 15 July 2008 – Revised 31 October 2008 – Accepted 2 November 2008 – First published online 15 January 2009)

Depending on type and inclusion level, dietary fibre may increase and maintain satiety and postpone the onset of hunger. This 7-week study evaluated the effect of fibre fermentability on physiological satiety-related metabolites and voluntary food intake (VFI) in dogs. Sixteen healthy adult dogs were fed a low-fermentable fibre (LFF) diet containing 8.5% cellulose or a high-fermentable fibre (HFF) diet containing 8.5% sugar beet pulp and 2% inulin. Large intestinal fibre degradation was evaluated by apparent faecal digestibility of nutrients and faecal SCFA and NH3 concentrations. Postprandial blood samples were obtained to determine postprandial plasma glucose, insulin, total peptide tyrosine–tyrosine (PYY), total glucagon-like peptide-1 (GLP-1) and total ghrelin concentrations. At the end of the study, the dogs were given a single meal of a dry dog food to determine VFI. Dogs fed the HFF diet had a significantly higher large intestinal fibre degradation and production of SCFA compared with the dogs fed the LFF diet. The HFF-fed dogs tended (P=0.058) to show a lower VFI at the end of the study. No treatment effects were found for postprandial plasma glucose, PYY, GLP-1 and ghrelin responses. The concentrations of these metabolites could not be related to the observed difference in VFI. The inclusion of fermentable fibre in canine diets may contribute to the prevention or mitigation of obesity through its effects on satiety. The underlying mechanisms require further investigation.

Dietary fibre type: Dogs: Satiety hormones: Insulin

Abbreviations: ADC, apparent digestibility coefficient; ADF, acid-detergent fibre; AUC, area under the curve; BW, body weight; GLP-1, glucagon-like peptide-1; HFF, high-fermentable fibre; LFF, low-fermentable fibre; NDF, neutral-detergent fibre; PYY, peptide tyrosine–tyrosine; TDF, total dietary fibre; VFI, voluntary food intake.

* Corresponding author: Guido Bosch, fax +31 317 484260, email guido.bosch@wur.nl
Fibre type and satiety in dogs

319

The inclusion of fermentable fibres in the diets of dogs during an oral glucose tolerance test (11) has prolonged gastric emptying and decreased the concentration of glucose in the blood (12). This may influence satiety directly by altering the rate of gastric emptying, or indirectly by influencing the rate of nutrient absorption and gut hormone secretion (13). The aim of the present study was therefore to investigate the effect of dietary fibre on satiety in dogs following a meal. The dogs were fed one of two experimental diets formulated to be iso-nitrogenous and iso-energetic on a metabolisable energy basis, and iso-fibrous on a total dietary fibre (TDF) basis. Ingredient composition of both diets is shown in Table 1. The LFF diet contained cellulose as a fibre source, whereas the HFF diet contained a combination of sugar beet pulp and inulin. Differences in fermentability between fibre sources were studied in vitro (21,22).

The content of molasses in the sugar beet pulp was estimated to be 5% and an identical amount of molasses was added to the LFF diet. TiO2 (2 g/kg diet) was included as an inert digestibility marker (21).

There is still little information available regarding the potency of various fermentable fibres to affect the satiety in dogs. The aim of the present study was therefore to investigate whether an increase in dietary fibre fermentability prolongs the duration of postprandial satiety as measured by VFI and physiological satiety metabolites when included in the diets of dogs.

Experimental methods

Animals

Sixteen (eight males and eight females) healthy adult beagle dogs aged between 2 and 6 years with an initial BW between 7.2 and 11.4 kg were individually housed in indoor pens at the Laboratory of Animal Nutrition of Ghent University (Merelbeke, Belgium). Dietary treatments were equally distributed among pens. The dogs were assigned to one of two dietary treatments: low-fermentable fibre (LFF) or high-fermentable fibre (HFF) according to BW and sex (blocking factors) resulting in a mean BW of 9.7 (SEM 0.5) and 9.7 (SEM 0.4) kg for the LFF and the HFF groups, respectively. All the dogs were weighed before the start of the experiment and thereafter every 2 weeks until the end of the experiment. Each dog was fed individually to meet its maintenance energy requirement estimated at 415 kJ metabolisable energy/kg BW0.75 (20). The diets were fed twice daily in two equal portions at 08.30 and 18.30 hours after mixing with an equal amount of lukewarm water to increase palatability. Food intake was recorded during each meal throughout the entire experimental period and freshwater was provided ad libitum. All animal housing, care and experimental procedures were approved by and conformed to the requirements of the Ethical Committee of the Faculty of Veterinary Medicine of the Ghent University (Belgium, EC 2007/40).

Diets

The dogs were fed one of the two experimental diets formulated to be iso-nitrogenous and iso-energetic on a metabolisable energy basis, and iso-fibrous on a total dietary fibre (TDF) basis. Ingredient composition of both diets is shown in Table 1. The LFF diet contained cellulose as a fibre source, whereas the HFF diet contained a combination of sugar beet pulp and inulin. Differences in fermentability between fibre sources were studied on the in vitro basis (21,22).

The content of molasses in the sugar beet pulp was estimated to be 5% and an identical amount of molasses was added to the LFF diet. TiO2 (2 g/kg diet) was included as an inert digestibility marker (21).

Chemical analyses

The diets were analysed for DM, ash, starch, sugar, crude protein, crude fat, TDF, insoluble dietary fibre, neutral-detergent fibre

Table 1. Composition of the low-fermentable fibre (LFF) and high-fermentable fibre (HFF) diets

<table>
<thead>
<tr>
<th>Ingredient composition (g/kg DM)</th>
<th>LFF</th>
<th>HFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash</td>
<td>37-5</td>
<td>42-0</td>
</tr>
<tr>
<td>Starch</td>
<td>372-4</td>
<td>367-5</td>
</tr>
<tr>
<td>Sugar</td>
<td>13-6</td>
<td>41-6</td>
</tr>
<tr>
<td>Crude protein</td>
<td>274-1</td>
<td>262-2</td>
</tr>
<tr>
<td>Crude fat</td>
<td>191-4</td>
<td>191-2</td>
</tr>
<tr>
<td>TDF</td>
<td>123-7</td>
<td>93-9</td>
</tr>
<tr>
<td>IDF</td>
<td>110-9</td>
<td>74-7</td>
</tr>
<tr>
<td>SDF¶</td>
<td>12-8</td>
<td>19-2</td>
</tr>
<tr>
<td>ADL</td>
<td>139-4</td>
<td>99-5</td>
</tr>
<tr>
<td>ADF</td>
<td>93-9</td>
<td>41-7</td>
</tr>
<tr>
<td>ADL</td>
<td>11-1</td>
<td>10-8</td>
</tr>
<tr>
<td>NSP§</td>
<td>111-0</td>
<td>95-1</td>
</tr>
<tr>
<td>Energy content (kJ/100g DM)</td>
<td>2294</td>
<td>2300</td>
</tr>
</tbody>
</table>

LFF, total dietary fibre; IDF, insoluble dietary fibre; SDF, soluble dietary fibre; NDF, neutral-detergent fibre; ADF, acid-detergent fibre; ADL, acid-detergent lignin.

* Wheat starch, Pregel Wheat Alpha (Meneba, Weert, The Netherlands); poultry meat meal, Meat Meal 63 (Sonac, Lingen, Germany); poultry fat (Sonac, Lingen, Germany); cellulose, Arbocect BW40 (J. Rentenmaer Benelux, Zultphen, The Netherlands); sugar beet pulp, molasses (Research Diet Services, Wijk bij Duurstede, The Netherlands); inulin, Beneo IPS (Orafti, Tienen, Belgium); premix (Talijin B.V., Stroe, The Netherlands); digest, Lusus Digest N8008 (AFB International, Nuland, The Netherlands); titanium (IV) oxide (Sigma-Aldrich Chemie B.V., Zwijndrecht, The Netherlands).

† The premix provided per kilogram of diet: Ca, 0.41 g; P, 0.07 g; Mg, 0.05 g; K, 0.1 g; Na, 0.01 g; Cl, 0.09 g; linoleic acid, 0.1 g; PUFA, 0.17 g; lysine, 0.06 g; methionine, 0.02 g; methionine + cysteine, 0.04; threonine, 0.04 g; tryptophan, 0.02 g; retinol, 5.25 mg; vitamin D3, 50 µg; vitamin E, 100 mg; vitamin K3, 2 mg; vitamin B1, 10 mg; vitamin B2, 10 mg; niacin, 50 mg; pantothenic acid, 25 mg; vitamin B6, 7.5 mg; vitamin B12, 50 µg; biotin, 300 µg; choline chloride, 475 mg; folic acid, 1.25 mg; vitamin C, 100 mg; Fe, 75 mg; Mn, 35 mg; Cu, 5 mg; Zn, 75 mg; I, 1.75 mg; Co, 2 mg; and Se, 0.2 mg.

‡ Calculated by subtracting the IDF content from the TDF content.

§ Derived by subtracting the crude protein, crude fat, starch and sugar content from the organic matter content (17). Inulin was included in the analysed sugar content, the NSP content of the HFF diet is underestimated with approximately 18 g/kg DM (20 g/kg included in the diet with 90% pure inulin).

**NS**
(NDF), acid-detergent fibre (ADF), acid-detergent lignin and Ti. DM and ash contents were determined by drying to a constant weight at 103°C and combustion at 550°C, respectively. The starch content was analysed enzymatically(24), while reducing sugars were extracted from the feed samples using 40% ethanol and determined as described by Suarez et al. Crude protein (6·25 × N) was determined using the Kjeldahl method (ISO 5508-1, 2005) and crude fat was analysed according to a modified method of Van Soest and Goelena et al. (29). The soluble dietary fibre content was calculated by subtracting the insoluble dietary fibre content from the TDF content. Note that the inulin would not be recovered in the TDF fraction(28). NDF was analysed in defatted diet samples (fat extraction with petroleum-ether) according to a modified method of Van Soest et al. (29) described by Goelena et al. (30). The ADF and acid-detergent lignin contents were determined according to Van Soest et al. (31). Ti was analysed using a modified method based on the work by Short et al. (32) and Myers et al. (33). The content of NSP was calculated by subtracting the starch, sugar, crude protein and crude fat content from the organic matter content (17). As inulin was included in the analysed sugar content, the NSP content of the HFF diet is underestimated with approximately 18 g/kg DM (20 g/kg included in the diet with 90% pure inulin).

**Apparent digestibility**

After 10 d of adaptation to the experimental diets, a 3 d faecal collection was conducted for the determination of apparent digestibility of nutrients. On these days, all faeces produced by each dog were collected twice a day and weighed. The faeces were freeze-dried to a constant weight, pooled per dog and ground over a 1 mm sieve in a Retsch mill (ZM100, Retsch B.V., Ochten, The Netherlands). Then the faeces of each dog were analysed for DM, ash, crude protein, crude fat, NDF, ADF, acid-detergent lignin and Ti, according to the procedures described previously. Starch and sugar were not analysed as these were assumed to be completely digested and absorbed. The NSP content of faeces was calculated by subtracting the crude protein and fat contents from the organic matter content. The apparent digestibility coefficient (ADC) for the nutrients was calculated using the following equations:

\[
\text{Nutrient}_{\text{flow}} = \frac{\text{Nutrient}_{i} \times Ti_{i}}{Ti_{y}},
\]

\[
\text{ADC} (\%) = \frac{\text{Nutrient}_{i} - \text{Nutrient}_{\text{flow}}}{\text{Nutrient}_{i}} \times 100 \% ,
\]

where Nutrient\textsubscript{flow} is the nutrient flow (g/d), Nutrient\textsubscript{i} is the nutrient content of faeces (g/kg DM), Ti\textsubscript{i} is the Ti intake (g), Ti\textsubscript{y} is the Ti content of faeces (g/kg DM) and Nutrient\textsubscript{i} is the nutrient intake (g/d).

**Faecal consistency and fermentation products**

To evaluate colonic microbial fermentative activity for both dietary treatment groups, fresh faeces were collected from each dog during week 5 of the experiment within 15 min of defecation. Faeces consistency was scored using the following system(34): 1 = hard, dry pellets – small, hard mass; 2 = hard, formed, dry stool – remains firm and soft; 3 = soft, formed moist – softer stool that retains shape; 4 = soft, unformed – stool assumes shape of container; 5 = watery – liquid that can be poured. Directly after faecal scoring, the faeces were collected and homogenised using two spoons whereafter the samples were taken for SCFA, NH\textsubscript{3} and DM contents. All materials used for faeces collection and sampling were pre-sterilised using 70% ethanol. For the determination of faecal SCFA and NH\textsubscript{3} content, a sample of approximately 0·5–10 g was added to a 2 ml safe-lock tube (Eppendorf AG, Hamburg, Germany) containing 1·0 ml of 0·033 M H\textsubscript{3}PO\textsubscript{4} for SCFA analysis or 1·0 ml of 10% TCA for NH\textsubscript{3} analysis. After the addition of faeces, the contents of each tube were mixed on a vortex for 3 s, weighed and stored at −20°C. For DM determination, approximately 1·5 g of faeces was added to a pre-weighed 2 ml safe-lock tube (Eppendorf AG), weighed and stored at −20°C. For the determination of SCFA and NH\textsubscript{3}, the samples were thawed, mixed and centrifuged at 15 000 rpm for 5 min at 4°C (Centrifuge 5417R, Eppendorf AG). Concentrations of the SCFA (i.e. acetate, propionate, butyrate, iso-butyrate, valerate, iso-valerate) in the supernatant were determined as described by Bosch et al. Branched-chain proportion was calculated as the percentage of branched-chain fatty acids (iso-butyrate, valerate, iso-valerate) of total SCFA. The faecal DM content was determined by freeze-drying to constant weight and used to calculate SCFA and NH\textsubscript{3} content in the original faeces.

**Blood sampling and plasma analyses**

Blood sampling was performed in week 6 of the experiment. The dogs were sedated using 0·02 ml/kg BW methadone hydrochloride (Mephenon®, Denolin, Brussels, Belgium) and a central venous catheter (18G/20 cm Leaderflex®, Vygon, Écouen, France) was placed in the jugular vein. The catheters were flushed with 1 ml heparinised saline (0-1 mg heparin/ml saline solution) directly after catheter placement and just before the sampling procedure. Furthermore, at the time of placement of the catheter, 15 mg/kg BW amoxicillin (Clamoxyl LA®, GlaxoSmithKline N.V., Genval, Belgium) was administered subcutaneously. Blood samples (2·5–3·0 ml) were obtained from each dog 30 min prior to feeding and 20, 40, 60 and 90 min postprandial. Thereafter, blood was sampled from four dogs in each group at 120, 180, 240, 300, 360, 420, 480 and 540 min after feeding, while the other four dogs in each group were sampled at 150, 210, 270, 330, 390, 450, 510 and 570 min after feeding. The blood samples were collected in chilled collection tubes containing K\textsubscript{2}EDTA as an anticoagulant. After gentle mixing of the contents, each collection tube was opened and 25 µl dipeptidyl peptidase-IV inhibitor (Linco Research, MI, USA) and 125 µl TrasyloL® (1·4 mg aprotinin/ml, Bayer AG, Leverkusen, Germany) were added. After gentle mixing of the contents, the tubes were temporarily stored on ice until centrifugation at 2500 g for 15 min at 4°C. After centrifugation, plasma was removed and stored in safe-lock tubes (Eppendorf AG) at −20°C until analysis. Each blood sample was processed within 30 min after collection. Blood plasma was analysed for glucose, insulin, total PYY, total GLP-1.
and total ghrelin concentration. Plasma glucose was analysed according to the hexokinase method using a commercial test kit (Human GmbH, Wiesbaden, Germany), while plasma insulin, total PYY and total ghrelin were analysed using commercial RIA kits (human-specific insulin RIA kit, Linco Research; rat/mouse PYY RIA kit, Linco Research; and total ghrelin RIA kit, Linco Research, respectively). Plasma GLP-1 was analysed using an RIA specific for the C-terminal of the amidated GLP-1 (36, 37). The intra-assay CV for the assays were 7-1% for insulin, 6-2% for ghrelin, 14-8% for PYY and 6% for GLP-1. The values obtained at 120 and 150, 180 and 210, 240 and 270, 300 and 330, 360 and 390, 420 and 450, and 480 and 540 min postprandial were analysed together and are presented as time points 135, 195, 255, 315, 375, 435 and 495 min, respectively. The basal concentration was defined as the average of the level in the first and last samples (30 min before the morning feeding and 45 min before the evening feeding, respectively). For PYY, GLP-1 and ghrelin, the area under the curve (AUC) from basal until 195 min after the meal and the AUC from 195 to 495 min after the meal for each measured parameter were approximated using the trapezoidal summation. Trapezoids were calculated as the length of the base (interval time between consecutive samples in min) times the average of the heights of the two sides (concentrations of consecutive samples). The time intervals were selected based on a minimal oro-caecal transit time of approximately 2-7 h in Standard Schnauzers with a BW of 12.9 (SEM 2.1) kg (38). From this time onwards, the digesta arrives in the large intestine and fermentable dietary fibre becomes available for the microbial population and SCFA may be produced.

**Voluntary food intake**

At the end of the study (week 7), each dog was offered 1 kg of the dry extruded control diet that dogs previously experienced as palatable (Hill’s Science Plan Canine Adult with Beef, Hill’s Pet Nutrition Inc., Topeka, KS, USA). The dogs were allowed to eat to 20 min, after which food intake was recorded. The diet was offered to each dog at precisely 6 h after the morning feeding (14.30 hours).

**Statistical analyses**

The dogs were randomly allocated to the two treatments according to the BW and sex. All data were analysed using the Statistical Analysis Systems statistical software package version 9.1 (SAS Institute, Cary, NC, USA). Differences in the ADC of nutrients, faecal characteristics (faecal score, DM, SCFA and NH₃) and plasma metabolites (the basal concentration of glucose, insulin, PYY, GLP-1 and ghrelin and AUC (0–195 and 195–495 min) of PYY, GLP-1 and ghrelin) between the dietary treatment groups were tested for significance using ANOVA by Proc GLM. The model used was

\[ Y = \mu + D_i + T_j + (D \times T)_{ij} + \epsilon_{ij}, \]

where \( Y \) is the dependent variable, \( \mu \) is the average intercept, \( D_i \) is the effect of diet \( i \) and \( \epsilon_{ij} \) is the error term. The basal concentrations were significant (\( P<0.010 \)) and included in the model as covariate. The correlations between VFI and plasma glucose and hormone concentrations were calculated using the Proc CORR statement. Differences were considered to be significant at \( P \leq 0.05 \).

**Results**

All dogs remained healthy throughout the study, although a general decrease in the BW was observed for both groups (approximately 5 % BW loss for each dietary treatment). No significant differences were found between the dietary treatments in the BW at the start and end of the experiment and BW loss (P=0.906; 0.909 and 0.927, respectively; data not shown). One dog in the LFF treatment group lost substantial BW during the trial and showed very high concentrations of ghrelin compared with the other dogs. The obtained physiological and VFI data from this dog were therefore excluded from the statistical analyses.

**Apparent digestibility**

The dogs fed the HFF diet showed higher ADC for DM and organic matter (\( P<0.001 \)), whereas the LFF-fed dogs had a higher ADC for crude fat (\( P<0.001 \)) and tended to have a higher crude protein digestibility (\( P=0.099 \); Table 2). The NSP digestibility was higher for the HFF diet compared with the LFF diet (\( P<0.001 \)). In addition, the dogs fed the HFF diet showed higher ADC for NDF (\( P<0.001 \)) and ADF (\( P=0.002 \)) and tended to have a lower ADC for acid-detergent lignin (\( P=0.082 \)) compared with the dogs fed the LFF diet. Finally, the ADC for energy was higher for the HFF-fed dogs compared with the LFF-fed dogs (\( P<0.001 \)).

**Table 2. Apparent digestibility coefficient (ADC, %) for nutrients and energy in the low-fermentable fibre diet (LFF) or the high-fermentable diet (HFF) fed to dogs**

<table>
<thead>
<tr>
<th></th>
<th>LFF</th>
<th>HFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>Mean</td>
<td>SEM</td>
</tr>
<tr>
<td>OM</td>
<td>80.6</td>
<td>0.25</td>
</tr>
<tr>
<td>Crude protein</td>
<td>77.3</td>
<td>0.81</td>
</tr>
<tr>
<td>Crude fat*</td>
<td>92.3</td>
<td>0.18</td>
</tr>
<tr>
<td>NDF</td>
<td>3.3</td>
<td>0.96</td>
</tr>
<tr>
<td>ADF</td>
<td>43.7</td>
<td>4.13</td>
</tr>
<tr>
<td>ADL</td>
<td>2.8</td>
<td>0.69</td>
</tr>
<tr>
<td>Gross energy</td>
<td>82.7</td>
<td>0.25</td>
</tr>
</tbody>
</table>

* Due to the limited amount of faecal material available for the analysis, the values presented were based on seven dogs for the LFF treatment and six dogs for the HFF treatment.
Faecal consistency and fermentation products

Significant differences in the faecal characteristics between the treatment groups were observed (Table 3). The faecal DM content was lower for the dogs fed the HFF than the LFF (P<0.001) diet. Compared with the dogs fed the LFF diet, higher total SCFA, acetate and propionate concentrations were found for the dogs fed the HFF diet (P<0.001). Moreover, butyrate concentrations tended to be higher in the HFF dogs (P=0.060). The dogs fed the LFF diet showed a higher branched-chain ratio and NH₃ concentration in the faeces compared with the dogs fed the HFF diet (P=0.002 and 0.009, respectively). No treatment effect was found for faecal consistency score (P=0.590).

Plasma metabolites

Plasma glucose, insulin, PYY, GLP-1 and ghrelin parameters for both the dietary groups are shown in Table 4. The basal concentrations of the measured metabolites were not different between the treatments groups (P>0.05). For all the measured metabolites, postprandial concentrations changed after the meal (P<0.01), but the concentrations were not affected by the dietary treatment (P>0.10 for diet and diet x time interaction, data not shown). No significant differences were found between the treatment groups in AUC₀–195 min and AUC₁₉₅–₄₉₅ min of PYY, GLP-1 and ghrelin (P>0.10).

Voluntary food intake

For each dog, the amount of food consumed at the end of the study was lower than the amount of food offered. The dogs fed the HFF diet tended to show a lower VFI compared with the dogs fed the LFF diet (P=0.058, Fig. 1). No significant correlations were found between VFI and glucose, insulin, PYY, GLP-1 or ghrelin concentration in plasma at 6 h after the meal (P>0.05, data not shown).

Discussion

The present study evaluated the impact of dietary fibre fermentability on the duration of postprandial satiety as measured by the hormones involved in satiation and VFI in dogs.

![Fig. 1. Voluntary food intake of the low-fermentable fibre (LFF) and high-fermentable (HFF) diet](https://www.cambridge.org/core/terms). IP address: 54.70.40.11, on 08 Jun 2019 at 16:02:00, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.

Table 3. Characteristics of the faeces of the dogs fed the low-fermentable fibre (LFF) diet and the high-fermentable (HFF) diet

<table>
<thead>
<tr>
<th></th>
<th>LFF Mean</th>
<th>SEM</th>
<th>HFF Mean</th>
<th>SEM</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM (g/kg)</td>
<td>379.1</td>
<td>15.5</td>
<td>231.0</td>
<td>9.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total SCFA (mmol/g DM)</td>
<td>0.26</td>
<td>0.02</td>
<td>0.54</td>
<td>0.04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Acetate (mmol/g DM)</td>
<td>0.14</td>
<td>0.02</td>
<td>0.32</td>
<td>0.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Propionate (mmol/g DM)</td>
<td>0.06</td>
<td>0.01</td>
<td>0.14</td>
<td>0.01</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Butyrate (mmol/g DM)</td>
<td>0.03</td>
<td>0.00</td>
<td>0.05</td>
<td>0.01</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BCP (%)*</td>
<td>8.51</td>
<td>0.87</td>
<td>4.40</td>
<td>0.68</td>
<td>0.002</td>
</tr>
<tr>
<td>NH₃ (mg/g DM)</td>
<td>2.73</td>
<td>0.24</td>
<td>3.45</td>
<td>0.53</td>
<td>0.240</td>
</tr>
<tr>
<td>NH₃ (mg/ml faecal water)</td>
<td>1.66</td>
<td>0.15</td>
<td>1.02</td>
<td>0.15</td>
<td>0.009</td>
</tr>
<tr>
<td>Faecal score (1–5)</td>
<td>2.44</td>
<td>0.11</td>
<td>2.50</td>
<td>0.00</td>
<td>0.590</td>
</tr>
</tbody>
</table>

BCP, branched-chain proportion.
* Calculated as the percentage of branched-chain fatty acids (iso-butyrate, valerate, iso-valerate) of total SCFA(23).

The selection of fibre sources was based on the in vitro fermentation studies(21,22), that showed a low microbial degradability for cellulose and moderate and rapid fermentability for, respectively, sugarbeet pulp and inulin using the faeces from the dogs as inoculate. The difference in fibre degradability between the two diets was also shown in the present study. The dogs fed the HFF diet showed a higher ADC for NDF, ADF and NSP compared with the LFF-fed dogs, indicating a higher intestinal microbial degradability of those fibre sources used in the HFF diet. The higher microbial fibre degradation in the HFF-fed dogs resulted in a higher SCFA production, also reflected in a higher SCFA concentration in the faeces of these dogs. In the case of low availability of fermentable fibre (as with the LFF diet), the microbial population...
Fibre type and satiety in dogs

[The natural text is a continuation of the previous discussion on satiety and appetite in dogs fed different diets, focusing on the role of SCFA in influencing satiety and appetite. It discusses the potential impact of dietary fibre, particularly fermentable fibre, on satiety and appetite, and the role of SCFA in the gut. The text also refers to previous studies by Johnson (52) and Neary et al. (55) and mentions the importance of postprandial glucose concentrations in satiety and appetite regulation.]

In conclusion, the present study showed that the dogs fed the HFF diet had an increased large intestinal fibre degradation and the production of SCFA compared to those fed the LFF diet. The HFF-fed dogs consumed less food during a challenge meal, which may be related to increased feelings of satiety. Postprandial plasma PYY, GLP-1, ghrelin and glucose responses did not differ between the treatment groups and could not be linked to the observed reduced voluntary food consumption of the dogs fed the HFF diet. It is likely that other satiety-related hormones and/or mechanisms controlling the feelings of satiety or hunger may have been involved in the observed decrease in VFI in the present study. Finally, inclusion of fermentable fibre in canine diets may contribute to the prevention or mitigation of obesity through its effects on satiety.
Acknowledgements

The present study was supported by the Wageningen Institute of Animal Sciences and the Laboratory of Animal Nutrition, Ghent University. George Fahey Jr is acknowledged for his advice concerning the composition of the experimental diets. The authors sincerely thank Steven Galle, Rebekka Hollebosc, Mariette Kooper, Yvonne Pajimans, Georgios Papadopoulos and Herman De Rycke involved in the caretaking of the dogs and/or sample collection. All authors contributed fundamentally to the present study. G. B. contributed to all facets including research design, data collection, analyses, interpretation and manuscript preparation; W. H. H., M. H., G. P. J. J. and A. F. B. v. d. P. contributed to research design, data interpretation and manuscript preparation; A. V. and M. H. contributed to animal expertise, blood-collection protocol, blood collection and manuscript preparation; J. J. H. contributed to GLP-1 analyses, data interpretation and manuscript preparation. The authors declare that there is no conflict of interest.

References


