Fatty Acid Composition in Commercial Dog Foods

Øystein Ahlstrøm,* 2 Åshild Krogdahl,† Stine Gregersen Vhile,* and Anders Skrede*

‘Department of Animal and Aquacultural Sciences, Agricultural University of Norway, N-1432 Ås, Norway
and †Department of Basic Sciences and Aquatic Medicine, Norwegian School of Veterinary Science, N-0033 Oslo, Norway

EXPANDED ABSTRACT

KEY WORDS: • dog foods • essential fatty acids • nutrition

Dietary fat supplies essential fatty acids (EFA) and is crucial for carrying fat-soluble vitamins. Fat is also the most energy-concentrated nutrient, and is important for palatability and texture in pet food. In dry extruded dog food, the fat source can be of either animal or vegetable origin or often a mixture of both. Which fat sources the food producer will include in dog food will depend on several factors such as content of EFA, melting point of the fat (saturation), effect on palatability, susceptibility for oxidation, and market price.

As of 1985, linoleic acid (18:2 n-6) (LA) was the only EFA listed for dogs by the National Research Council (1). From LA, dogs can synthesize arachidonic acid (20:4 n-6) (AA), which is an essential cell membrane constituent. In humans, both LA and the parent fatty acid from the (n-3) series, α-linolenic acid, 18:3 (n-3) (ALA), have been established as essential and beneficial to health. In dogs, a requirement for (n-3) fatty acids has not been documented, but may exist at certain stages in their life cycle. If the requirement for (n-3) EFA is low, mother’s milk and food rations may provide sufficient amounts to prevent deficiency symptoms. However, there are indications that foods occasionally are deficient in essential fatty acids, as skin defects in adult dogs may be alleviated or cured by changing food or by supplementation with vegetable or marine oils. Pruritic skin diseases in dogs have become significantly less severe after supplementing marine oils rich in eicosapentaenoic acid, 20:5 (n-3) (EPA), and docosahexanenoic acid, 22:6 (n-3) (DHA), than after dietary supplementation with (n-6) fatty acids (2). Numerous fatty acid supplements are sold by veterinarians to reduce problems with the coat and skin in dogs. Most of these supplements contain a mixture of (n-6) and (n-3) fatty acids, and often include EPA and DHA from marine sources. Recent discussions on EFA for dogs, have involved (n-3) fatty acids and the relationship between dietary EFA (n-6):(n-3) fatty acids. This study aimed at investigating fatty acid composition in commercial dry dog foods to monitor existing variation among different foods.

MATERIAL AND METHODS

Twelve brands of dog food sold in Norway were included in the study. When puppy or puppy large breed foods were available on the Norwegian market, these were chosen. The foods were: Precept (large breed puppy), Texas Farm Products Company, Nacogdoches, TX; Kaisa (adult), Kaisa Hundefôr, Sarpsborg, Norway; Eukanuba (large breed puppy), Iams Company, Coevorden, The Netherlands; Proplan (puppy), Nestlé Purina PetCare, St. Louis, MO; Specific (adult), Leo Animal Health, A/S, Udlem, Denmark; Hill’s Pet Nutrition, The Netherlands; Pedigree (puppy), Masterfoods AB, Malmö, Sweden; Doggy, Doggy AB, Vårgårda, Sweden; Labb (puppy), Felleskjøpet, Oslo, Norway; Friskies (puppy), Nestlé Purina PetCare, St. Louis, MO; Troll (puppy) Troll Hundefôr, Trondheim, Norway; Royal Canine (large breed puppy), Royal Canin S.A., Almarques, France.

Three independent bags of food with a different batch number for each brand were mixed and analyzed for total contents of fat and fatty acid composition. The foods were analyzed for crude fat by the HCl-ether extraction method approved by the European Community. Fatty acids were analyzed after one-step extraction/methylation (3). The analyses were carried out at AnalyCen Laboratory, Lidköping, Sweden. The metabolizable energy (ME) content was measured in digestibility experiments with mink by using 18.8, 39.7, and 17.6 kJ/g digestible protein, fat, and carbohydrates, respectively. Apparent digestibility values of protein and fat were applied. Mink digestibility was chosen as a model because of its documented high correlation to digestibility in dogs (4). Protocols of the digestibility experiment in mink are given elsewhere (4,5). Because individual fatty acid digestibility was not determined, digestibility values of EFAs were estimated to 95%. This proximation is supported by a comparative total fat and fatty acid
digestibility study in mink (6). The digestible content of EFA was used to estimate the ME contribution from EFA (% of ME). Each gram of digestible EFA accounted for 37.9 kJ ME in the calculation (see above).

RESULTS AND DISCUSSION

Crude fat contents were close to the declared values printed on the package. Saturated, monounsaturated, and polyunsaturated fatty acid contents of the diets varied between 27.7 and 40.5%, 31.6–45.0%, and 18.1–43.1%, respectively (Table 1).

LA accounted for 14.0% of the total fat at the lowest level (Food 12) and 36.2% at the highest (Food 6). The contents of γ-linolenic acid (GLA) were low and not different among diets. For AA the differences were distinct among diets, varying from 0.2% for Food 7 to 0.7% for Food 3. The concentration of EPA and DHA in the diets showed that marine oils or marine products were practically absent in some foods (e.g., Food 10) or present at a quite high level in others (e.g., Foods 2, 4, 5, and 11). Food 6 differed from the other diets by having the highest total (n-3) fatty acids, which were made up entirely of ALA, whereas concentrations of EPA and DHA were very low.

The (n-6):(n-3) relationships of the diets and the dietary level of EFA (Table 1) showed that the food producers have had different strategies for choosing their fat sources to provide adequate dietary EFA levels. The ratio of (n-6):(n-3) is, however, not considered useful for characterizing optimum recommendations for EFA (7). The reason for this is that ALA is not metabolically equivalent to EPA or DHA. ALA is a precursor for EPA and DHA, but the conversion is inefficient. Furthermore, a decrease in dietary consumption of (n-6) PUFA does not produce similar effects as an increase in (n-3) PUFA intake. Dietary characterization given as (n-6):(n-3) relationship should therefore be interpreted with caution. An example of this from this study is demonstrated when comparing Food 6 and Food 11. The foods had the same (n-6):(n-3) ratio, but for Food 6 ALA is the dominating (n-3) fatty acid and

### TABLE 1

<table>
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<tr>
<th>Diet no.</th>
<th>DM (%)</th>
<th>ME (%)</th>
<th>Crude fat</th>
<th>SFA</th>
<th>MUFA</th>
<th>PUFA</th>
<th>LA</th>
<th>GLA</th>
<th>AA</th>
<th>Total (n-6)</th>
<th>ALA</th>
<th>EPA</th>
<th>DHA</th>
<th>Total (n-3)</th>
<th>(n-6):(n-3)</th>
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Average: 92.7, 14.6, 13.9, 33.5, 39.9, 24.4, 20.5, 0.11, 0.38, 21.0, 2.1, 0.34, 0.46, 2.9, 8:1

6 ± SD: 0.7, 0.7, 2.2, 4.7, 3.4, 7.4, 6.6, 0.02, 0.13, 6.6, 1.4, 0.23, 0.36, 1.2, 3:1

n = 1. SFA, saturated fatty acids; MUFA, monounsaturated; PUFA, polyunsaturated; LA, linoleic acid (18:2 n-6); GLA, gamma linolenic acid (18:3 n-6); AA, arachidonic acid (20:4 n-6); ALA, alfa linolenic acid (18:3 n-3); EPA, eicosapentaenoic acid (20:5 n-3); DHA, docosahexaenoic acid (22:6 n-3); ND, not detected in analysis.

### TABLE 2

<table>
<thead>
<tr>
<th>Diet no.</th>
<th>LA, % of DM</th>
<th>AA, % of DM</th>
<th>ALA, % of DM</th>
<th>EPA + DHA, % of DM</th>
<th>EPA + DHA, % of DM</th>
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<td>0.14</td>
<td>0.29</td>
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</table>

6 ± SD: 0.81, 0.03, 0.06, 0.14, 0.36, 0.08, 0.21

n = 1. LA, linoleic acid (18:2 n-6); AA, arachidonic acid (20:4 n-6); ALA, alfa linolenic acid (18:3 n-3); EPA, eicosapentaenoic acid (20:5 n-3); DHA, docosahexaenoic acid (22:6 n-3). Digestibility of EFA estimated to 95%.
concentrations of EPA and DHA were very low, whereas for Food 11 levels of EPA and DHA were much higher (Table 1).

Concerning the individual EFAs, all diets contained sufficient amounts of essential (n-6) fatty acids according to NRC (1) recommended level of LA of 2–3% of ME. Table 2 shows that the lowest concentration of LA was recorded for Food 11 containing at 4.39% LA of ME corresponding to 1.82% of DM. The highest level of LA was found for Food 9 having 10.76% of ME from LA (4.46% LA of DM). For AA the dietary levels varied from 0.09% to 0.26% of ME corresponding to 0.03 and 0.12% of DM, respectively.

Levels of ALA, EPA, and DHA in relation to ME were considerably different among foods (Table 2). Some foods contained undetectable or very low levels of EPA and DHA (e.g., Foods 6, 7, and 10), whereas others contained almost 0.5% of ME from EPA and DHA (e.g., Foods 2–4). There have been many speculations about the (n-3) fatty acid requirement in dogs, but so far no specific requirement has been documented. However, recommendations for dietary allowances for (n-3) fatty acids will probably be proposed in the near future.

In general, eicosanoids formed from (n-3) fatty acids are much less potent in causing biological responses than those formed from (n-6) fatty acids, including for cytokine production and inflammatory responses. In humans it is realized that the consumed amounts and types of long-chain fatty acids of the (n-3) and (n-6) series can influence biological responses (8). Theoretically, addition of EPA and DHA in the diet causes displacement of AA in cell membranes, and a greater production of less inflammatory eicosanoids from EPA instead of proinflammatory eicosanoids from AA (2). It is possible that the relationship between (n-3) and (n-6) fatty acids in commercial dog food may influence inflammatory responses. A higher amount of (n-3) fatty acids in dog foods may be beneficial, especially in dogs with pruritus and other inflammatory disorders. Beneficial effects of continuous administration of dietary (n-3) polyunsaturated fatty acids in dogs with renal insufficiency have also been reported, and one of many possible causes for this is suggested to be the ability of (n-3) fatty acids to suppress inflammation (9).

Conclusions

Fatty acid composition in commercial dry dog foods, including contents of EFA, varies substantially. Differences in the levels of (n-6) and (n-3) EFA may explain some of the differences in biological responses to dog food observed by dog owners.

LITERATURE CITED