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ORIGINAL ARTICLE

Evaluation of the amount of metabolizable energy in the dogfood quantities recommended by the manufacturers to be fed daily to dogs, in relation to their energy requirements[#]

Evaluación del contenido de energía metabolizable en las cantidades de alimentos recomendadas diariamente para perros por los fabricantes en relación a los requerimientos energéticos

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RESUMEN

El objetivo del estudio fue determinar el aporte de energía metabolizable (ME) de las dietas al ser suministradas en las cantidades recomendadas por los fabricantes de alimentos comerciales a perros adultos en mantención y en crecimiento y compararlas con los requerimientos energéticos del perro. Se evaluaron marcas comerciales de alimentos secos formulados para perros adultos en mantención (15 marcas) y perros en crecimiento (15 marcas). Se confeccionaron muestras compuestas a partir de 3 lotes por formulación, las que fueron molidas y mezcladas con el marcador indigestible Cr_2O_3. Cada dieta para perros adultos en mantención fue suministrada a 8 perros adultos y cada dieta para perros en crecimiento fue suministrada a 8 perros en crecimiento, todos de la raza Labrador Retriever, por un período experimental de 8 días, luego de 8 días en los cuales los perros recibieron una dieta base. Durante los días 6, 7 y 8 de cada período experimental se recolectaron muestras de fecas individuales. A cada dieta se le determinó la concentración de ME. El contenido de ME en las cantidades de las dietas recomendadas por las fabricantes de los alimentos en perros adultos (10, 20 y 30 kg peso vivo) y perros en crecimiento (12 y 24 kg peso vivo) fue comparado con los requerimientos de ME calculados para estos animales. Dependiendo del peso vivo considerado para los perros, hasta 40% y 40% de las marcas recomendaron cantidades de su alimento que suministran menos ME y más ME, respectivamente, que el requerimiento del perro. Alimentar a los perros con las cantidades recomendadas de alimento podría llevarlos a una condición corporal por debajo o por encima de la correcta.

Key words: dog, metabolizable energy, energy requirements.

Palabras clave: perro, energía metabolizable, requerimiento energético.

INTRODUCTION

Obesity is a condition which can be defined as when an animal is 15% greater than its optimum bodyweight (Simpson *et al* 1993). While the prevalence of obesity in the dog population of Chile has not been determined, in other countries it has been shown to have a significant prevalence, with studies in the United States of America indicating that between 24 and 40% of the dog population suffer from obesity (Glickman *et al* 1995). Studies in Australia have reported a prevalence of 25% (Robertson 2003) and 33.5% (McGreevy *et al* 2005). The prevalence of obesity in the Chilean canine population could be expected to be of a similar magnitude.

The consequences of obesity include medical conditions such as hypertension (Brands *et al* 1995, Montoya *et al* 2006), insulin resistance, hyperinsulemia and hypertriglyceridemia (Brands *et al* 1995), and overall obesity clearly has detrimental affects on the health and longevity of the dog (German 2006). Obesity can also have welfare consequences with the dogs exhibiting a disinclination to play and they may be unable to participate in vigorous exercise, which can affect the human-animal relationship and reduce the social and health benefits of dog ownership (McGreevy *et al* 2005).

While obesity has shown to be related to age, with the prevalence generally being greater in older dogs (Colliard *et al* 2006), dogs that are obese as adolescents have an enhanced probability of being obese as adults (Glickman *et al* 1995).

Although obesity can be caused by some diseases such as hypothyroidism and hyperadrenocortism or certain pharmaceuticals in dogs, the main cause of canine obesity is a mismatch between energy intake and energy expenditure (German 2006). That is overfeeding the dogs and/or insufficient exercise.

In Chile, more than 95% of the dogfood sold is in the form of dry foods (USDA 2004), which almost always include recommendations on the packaging regarding

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the quantity of the dogfood that should be fed to dogs daily. However, the manner in which these quantities are determined depends on the manufacturer, with no standard methodology existing. It can be assumed that the majority of the owners will follow the recommended feeding amounts on the packaging. In this case, a potential cause of obesity in Chilean dogs would be that the quantities of dogfood that are recommended on the packaging will provide a greater amount of energy to the dog than the dog requires. Feeding these quantities of dogfood could, over time, result in obesity. It is important to note that studies have shown that dog owners tend to underestimate the body condition of obese dogs (Sibley 1984, Colliard *et al* 2006) and thus even though the animal is increasing in bodyweight, the owner in many cases is not likely to decrease the amount of the dogfood being fed to the animal.

Therefore, the hypothesis of the study described here was that the amount of energy contained in the quantities of commercially available dry dogfoods in Chile that are recommended by the manufacturers for dogs is greater than the energy requirement of the dogs.

MATERIAL AND METHODS

DIETS

A list of all dry dogfoods available commercially on the Chilean market was compiled in September of 2002 (a total of 43 brands of dogfood). From this list 15 brands were selected at random to be included in the present study. The commercial brands, manufacturers and country of origin of the 15 brands are presented in table 1.

A total of 15 kg of each of three batches (according to batch number or manufacturing date) of the formulations for adult maintenance and for growing dogs for each brand was obtained from supermarkets, veterinary clinics or specialized stores. For brands that contained more than one formulation for each of the two life-stages, the formulation for large breed dogs (over 25 kg) was obtained. The recommendations of the amount of each dogfood that should be fed to dogs according to the packaging were recorded.

For each of the two formulations for each brand, the dogfood was ground and the batches mixed to form one 45 kg sample of each formulation for each brand (a total of 30 samples). This sample was mixed with 2.5 g/kg of chromic oxide in a commercial mixer, a subsample of the diet was collected for subsequent analysis, and the diets were stored in sealed plastic bags for up to three weeks before use.

ANIMALS

A total of ten Labrador Retriever growing dogs (five males and five females) were used for the studies relating to the dogfood formulations for growing dogs. No more than three dogs pertained to the same litter. At the beginning of the study the dogs were 12 weeks-old. For the evaluations of formulations for adult dogs at maintenance, a total of ten non-pregnant and non-gestating Labrador Retriever dogs (five females and five males) between two and five years old at the beginning of the study were used. The female dogs received an anticonceptive medication every 6 months, following the conclusion of a diet evaluation.

Table 1. List of the commercial brands, manufacturer and country of origin of dry dogfoods evaluated in the present work.
Listado de marcas comerciales, fabricantes y país de origen de los alimentos evaluados.

Commercial brand	Manufacturer	Country of origin
Acomer	Tesko Ltda.	Chile
Bobican	Industria Punto Futuro S.A.	Chile
Cachupín	Nutripro S.A.	Chile
Cannes	Industria Punto Futuro S.A.	Chile
Champion	Champion S.A.	Chile
Dog chow/Puppy chow	Ralston Purina Argentina S.A.	Argentina
Doko	Nestle Argentina S.A.	Argentina
Eukanuba	The Iams Company	Argentina
Friskies Alpo	Nestle Argentina S.A.	Argentina
Masterdog	Nutripro S.A.	Chile
Pedigree	Effem Brasil Inc. & Cia.	Brazil
Precept	Precise Pet Products	USA
Pro Plan	Ralston Purina Company	USA
ProNature	PLB International Inc.	Canada
Sabrokan	Champion S.A.	Chile

While receiving the test diets, the dogs were housed in individual pens (2m x 5m) with cement floors. When the dogs were not receiving the test diets, they were housed in group pens (5 dogs per group) of 4.5 m x 4.3 m with cement floors, but were fed individually. Fresh water was available to the dogs at all times. Throughout the trial the dogs were exercised daily.

As the nutritional adequacy of all of the diets studied has not been previously evaluated, and the possibility existed that some of the diets may not fulfill all of the nutritional requirements of the dog, the commercial dogfoods Eukanuba® Large Breed Formula for Growing Dogs and Eukanuba® Large Breed Adult Maintenance (base diets) were fed to the growing and adult dogs, respectively, for the first 6 weeks (see below) and for a period of at least eight days before each test diet was fed. This was to ensure that no carryover effect occurred from one diet to the next. The Eukanuba® diets were chosen as they have passed the AAFCO Feeding Protocols for Dogs which demonstrate nutritional adequacy (AAFCO 2002). These diets have also been shown to contain adequate quantities of all nutrients in previous studies carried out by our group (Hodgkinson *et al* 2004, Hodgkinson SM, unpublished data).

Throughout the study, the adult dogs received their diet in two equal portions at 08:30 and 19:30h each day. For the first 6 weeks of the study, the adult dogs received their respective base diet. The quantity that each adult dog should receive was estimated, and fed to the dogs with their bodyweights recorded weekly and the amount of the base diet adjusted weekly until each dog was receiving the amount necessary to maintain their body weight, and a body condition of 3 (scale of 1-5, in which 1 is severely underweight and 5 is obese). This latter weight of each test dogfood was fed to the adult dogs throughout the study.

The growing dogs received their diet in three equal portions at 08:30, 16:30 and 19:30h each day. The growing dogs received their base diet during the first 6 weeks of the study, during which time for each dog, the quantity of the diet that was required to maintain a body condition of 3 (scale 1-5, as above) was determined. During the study, each time that the dogs received the base diet, their body condition was evaluated, and the quantity of diet given to each dog adjusted as necessary to maintain a body condition of 3.

The base diet was fed to the dogs for 8 days before each diet evaluation. For each diet evaluation, a total of 8 dogs (8 adult for the adult diets and 8 growing dogs for the diets for growing dogs) received the test diet mixed with water for a total of 8 days. During days 6, 7 and 8, a faecal sample was collected from each dog immediately upon defecation, and each sample was immediately frozen.

CHEMICAL ANALYSIS

Each of the faecal samples was individually freezedried and ground. For each of the faecal samples taken during days 6, 7 and 8 for each dog for each test diet, the same weight of sample was pooled to give one composite sample per dog per diet.

The diet and faecal samples were analyzed to determine their contents of dry matter (Bateman 1970), gross energy (bomb calorimeter, Bateman 1970), crude protein (Kjeldahl method, N x 6.25, Bateman 1970) and chromium (method described by Bateman 1970). All chemical analyses were carried out in duplicate.

CALCULATIONS

The ME requirements of an adult dog at maintenance with a body weight of 10, 20 and 30 kg were calculated using the equation presented by NRC (1985): ME = 132 $W^{0.75}$, where W represents body weight.

When a growing dog reaches 40% of its mature bodyweight (as would be the case of a 4 month old Labrador Retriever with bodyweight 12 kg) its ME requirement is expected to be 1.6 times that of its maintenance requirements, and when this dog reaches 80% of its mature bodyweight (as would be the case of an 8 month old Labrador Retriever with bodyweight 24 kg) its ME requirement is expected to be 1.2 times its maintenance requirements (NRC 1985, Meyer and Zenteck 1991). Using the equation given above to calculate the maintenance ME requirements for these growing dogs, the ME requirement of a 4-month old Labrador Retriever would be:

$$\begin{aligned} ME &= 1.6 \times (132 \times 12^{0.75}) \\ &= 1.6 \times 851 \\ &= 1362 \text{ kcal ME/day.} \end{aligned}$$

For an 8 month-old Labrador Retriever, the ME requirement would be:

$$\begin{aligned} ME &= 1.2 \times (132 \times 24^{0.75}) \\ &= 1.2 \times 1431 \\ &= 1718 \text{ kcal ME/day.} \end{aligned}$$

The contents of apparent digestible protein and energy of each diet were calculated using the formulae presented by AAFCO (2002) and the ME contents of each diet calculated from this value using the formula below (AAFCO 2002):

$$ME \text{ (kcal/kg food)} = [DE - (DP \times 1.25)] \times 1000$$

Where DE was digestible energy (kcal/kg food), DP was digestible protein (%), and 1.25 corresponds to the correction factor for energy lost in urine (1.25 kcal per g protein digested, AAFCO 2002, see discussion for more details).

The ME contents of the diets were used to calculate the amount of ME that the dogs would receive when given the amounts of the dogfoods recommended on the packaging

of each dogfood and these values were compared with the calculated ME requirements of the dogs.

To evaluate the digestible protein contents of the diets, the digestible protein contents of diets which contained over 4,000 kcal ME/kg DM were adjusted as described by AAFCO (2002), to take into consideration the lower feed intake expected with these diets. This correction is necessary as the dog regulates its diet consumption according to the ME content of its diet (AAFCO 2002).

RESULTS

At all times throughout the trial the dogs consumed all of their allowance of the test diets and each of the dogs maintained a good level of health throughout the study, with the exception of one adult dog that was removed for reasons that were not directly related to the study.

The contents of dry matter, crude protein, digestible protein, gross energy, metabolizable energy and digestibility of the protein in the diets are presented in table 2. There was a notable variation between diets in terms of their crude protein contents, both in the diets for growing dogs and those for adult dogs at maintenance. The mean crude protein content and content of digestible protein of the diets for growing dogs was greater than that for the adult dogs. The mean apparent protein digestibility of the diets for adult dogs was similar to that for the growing dogs, with means of 82.5 and 82.1%, respectively.

For the diets formulated for growing dogs, the ME content of the diets ranged from 3,507 to 4,584 kcal/kg DM, with ten of the 15 diets having a ME content greater than 4,000 kcal/kg DM. For the adult dogs, the ME content of the diets ranged from 3,178 to 4,405, with three diets containing over 4,000 kcal of ME/kg DM. On average 79% of the gross energy was available to the dogs (metabolizable energy/gross energy). The contents of crude protein and digestible protein in the diets following correction for the high energy content in diets containing over 4,000 kcal ME/kg DM are presented in table 3.

All of the dogfoods formulated for adult dogs at maintenance and all except one of the dogfoods formulated for growing dogs presented suggested feeding quantities on their packaging. The amounts of ME that these quantities of dogfood would contain (ME content x amount of dogfood) for adult dogs at maintenance and for growing dogs along with the ME requirements of these dogs are presented in tables 4 and 5, respectively. Tables 6 and 7 present the percentage of the dogfoods that presented feeding guidelines that recommended amounts of ME that were less than, equal to and greater than the ME

Table 2. Ranges, means and SEMs for content of dry matter, crude protein, digestible protein, gross energy, metabolizable energy and digestibility of the protein in commercial dog foods formulated for growing and adult dogs (dry matter basis).

Rangos, promedios y error estándar del promedio (SEM) del contenido de materia seca, proteína cruda, proteína digestible, energía bruta y energía metabolizable en alimentos comerciales para perros en crecimiento y perros adultos (base materia seca).

	Growing dogs			Adult dogs		
	Range	Mean	SEM	Range	Mean	SEM
Dry matter (%)	89.7-93.1	92.3	0.21	90.6-92.2	91.4	0.11
Crude protein (%)	25.4-39.0	30.1	0.84	19.3-30.4	24.2	0.74
Apparent protein digestibility (%)	75.7-89.8	82.1	0.94	76.5-87.7	82.5	0.87
Content of digestible protein (%)	20.7-32.6	24.9	0.73	14.8-26.3	20.0	0.79
Gross energy (kcal/kg)	4,850-5,370	5,070	50	4,640-5,280	4,885	46
Metabolizable energy (kcal/kg)	3,507-4,584	4,022	67	3,178-4,405	3,871	75

Table 3. Ranges, means and SEMs for content of crude protein and digestible protein following correction of energy density in foods containing over 4,000 kcal ME/kg DM, in commercial dog foods formulated for growing and adult dogs (dry matter basis).

Rangos, promedios y error estándar del promedio (SEM) del contenido de proteína cruda y proteína digestible después de corrección para densidad energética de alimentos con más de 4.000 kcal ME/kg en alimentos comerciales para perros en crecimiento y perros adultos (base materia seca).

	Growing dogs			Adult dogs		
	Range	Mean	SEM	Range	Mean	SEM
Crude protein (%)	23.6-33.1	26.8	0.67	19.2-25.7	23.0	0.53
Content of digestible protein (%)	19.8-27.1	22.0	0.48	14.8-21.8	19.0	0.54

Table 4. Energy requirements of adult dogs and the metabolizable energy (ME) content of the diet quantities recommended on the packaging of each dogfood for adult dogs at maintenance.

Requerimientos energéticos de perros adultos y contenido de energía metabolizable (ME) en las cantidades de alimentos sugeridas por cada marca comercial de alimentos para perros adultos en mantención.

		Dog with 10 kg bodyweight		Dog with 20 kg bodyweight		Dog with 30 kg bodyweight	
ME requirement (kcal/day)[a]		742		1248		1692	
ME content in amount of dogfood recommended to be fed (kcal EM/kg)		Min	Max	Min	Max	Min	Max
Test diet code	A-1	458	916	916	1831	1831	2594
	A-3	456	895	895	1561	1561	2333
	A-5	362	772	725	1309	1232	1773
	A-6	598	907	907	1215	1215	1632
	A-8	322	643	643	1286	1286	2573
	A-9	729	1400	1400	2041	2041	2654
	A-10	948	1327	1517	2086	2086	2844
	A-12[b]	–	–	–	–	831	1133
	A-13	526	790	790	1053	1053	1417
	A-14	577	827	827	1096	1096	1462
	A-2[c]	978		1564		1956	
	A-4[c]	725		1269		1994	
	A-7[c]	686		1200		1200	
	A-11[c]	697		1219		1916	
	A-15[c]	401		729		1093	

a Energy requirements calculated using equation of NRC (1984).

b Dogfood recommended only for dogs with bodyweight > 30 kg.

c Packaging presented a single recommendation as to the quantity to be fed to the dogs as opposed to a range of quantities.

requirements of these dogs, for growing dogs and adult dogs, respectively. For adult dogs with bodyweights of 10, 20 and 30 kg, 14, 21 and 40% of the brands, respectively, recommended quantities of dogfoods that would provide levels of ME that are greater than the dog's requirements. The situation was similar for the growing dogs.

DISCUSSION

In the study described here, feeding trials were conducted with Labrador Retriever dogs to determine the ME content of diets formulated for adult dogs at maintenance and growing dogs. Feeding trials, in which the dogs receive the diet in question and a complete collection of faeces and urine is conducted, are considered to be the most accurate methods for ME determination (Case *et al* 2000, Laflamme 2001). Conducting a complete collection of the faeces is, however, somewhat complicated in the dog, and requires the dog to be maintained relatively immobile during the entire collection process, which has strong animal welfare implications. As an alternative, indigestible markers, such as chromic oxide, can be incorporated into the test diets, and samples of faeces can be collected over three days, and then pooled to form one composite sample per dog (AAFCO 2002), as in the present study. Faecal digestibility coefficients of dry matter, crude protein, ether extract, nitrogen-free extract and energy determined from complete faecal collections have been shown not to differ from those determined with faecal sampling using chromic oxide as an indigestible marker, in the dog (Lôbo *et al* 2001).

The collection of urine from the dog, as well as requiring specialized metabolism cages, requires that the dog be maintained immobile throughout the collection period (normally a minimum of 24 hours), which is considered to be a controversial practice by animal welfare workers. As an alternative, only faeces can be collected, and the energy content of the urine is estimated according to the amount of digestible protein in the diet, which has been found to be highly correlated to the amount of energy present in the urine (Castrillo *et al* 2001). This alternative method

Table 5. Energy requirements of growing Labrador Retriever dogs with a body weight of 12 and 24 kg, and the ME content of the diet quantities recommended on the packaging of each dogfood for growing dogs.

Requerimiento energético de perros Labrador Retriever en crecimiento con peso vivo de 12 y 24 kg y cantidad de energía metabolizable (ME) en las cantidades de alimentos sugeridos por cada marca comercial de alimentos para perros en crecimiento.

		Dog with 12 kg bodyweight		Dog with 24 kg bodyweight	
ME requirement (kcal/day)[a]		1362		1718	
ME content in amount of dogfood recommended to be fed (kcal EM/kg)		Min	Max	Min	Max
Test diet code	C-1	2,237	2,685	4,475	5,370
	C-2	1,520	1,773	1,142	1,520
	C-3	1,066	1,777	2,843	3,554
	C-4	1,230	1,493	1,493	1,844
	C-5	784	1,195	1,437	2,221
	C-6	922	1,752	1,660	2,398
	C-7	1,525	2,458	1,441	2,119
	C-8	336	672	672	1,345
	C-10	1,503	1,754	1,129	1,503
	C-11	774	1419	1,419	2,065
	C-12	1,305	1,708	1,113	1,286
	C-13	975	1,949	1,822	2,627
	C-14	1,013	1,463	1,707	2,308
	C-15[b]	1,140		1,368	

[a] Energy requirements calculated as described in the text.

[b] Packaging presented a set recommendation as to quantity as opposed to a range of quantities.

Table 6. Percentage of the dogfoods formulated for adult dogs at maintenance which recommended quantities of dogfoods that would contain quantities of ME that are less than, equal to and greater than calculated dogs' ME requirement for dogs with bodyweights of 10, 20 and 30 kg.

Porcentaje de los alimentos formulados para perros adultos en mantención que recomendaron cantidades del alimento que contienen cantidades de energía metabolizable (EM) menor que, igual a y mayor que el requerimiento calculado de EM para perros con un peso vivo de 10, 20 y 30 kg.

Bodyweight	Less than	Equal to	Greater than
10	29	57	14
20	29	50	21
30	40	20	40

Table 7. Percentage of the dogfoods formulated for growing dogs which recommended quantities of dogfoods that would contain quantities of ME that are less than, equal to and greater than calculated Labrador Retriever dogs' ME requirement for dogs with bodyweights of 12 and 24 kg.

Porcentaje de los alimentos formulados para perros en crecimiento que recomendaron cantidades del alimento que contienen cantidades de energía metabolizable (EM) menor que, igual a y mayor que el requerimiento calculado de EM para perros Labrador Retriever con un peso vivo de 12 y 24 kg.

Bodyweight	Less than	Equal to	Greater than
12	21	50	29
24	36	43	21

has been found to result in ME values that do not differ from those determined following complete urine collections (Ohshima *et al* 1993). The methodology used in the present study, of conducting feeding trials to determine ME, with the feces sampled during three days (following a five-day period in which the dog has received the test-diet), without urine collection, is accepted as an adequate method to determine the ME content of a dogfood by the American Feed Control Officials (AAFCO 2002). The nutrient profiles, standards and regulations published by the AAFCO (AAFCO 2002) are accepted as the industry standard for the formulation of commercial diets for the dog. Furthermore, the Chilean dogfood standard (NCh 2546.Of2001) is based directly on the information published by the AAFCO.

For a dogfood to be nutritionally adequate for growing dogs, it must contain over 3,500 kcal ME/kg DM (AAFCO 2002). This lower limit in terms of energy content is due to the limited physical capacity of the digestive tract of the growing dog. In the present study all of the dogfoods formulated for growing dogs that were evaluated did contain a ME concentration greater than 3,500 kcal/kg. The nutrient profiles of AAFCO do not establish a lowest acceptable ME concentration for diets formulated for adult dogs. However, the model regulations published by the AAFCO (AAFCO 2002) do stipulate that for a dry diet (diet with < 20% DM) to be labeled "light", "lite" or "low calorie", ie. diets that are marketed for weight loss in dogs, they must not contain more than 3,100 kcal ME/kg as fed (not on a DM basis). One of the maintenance diets evaluated in this study contained a ME content of 2,916 kcal ME/kg. This diet would be expected to result in a loss of bodyweight in the animals receiving it. When the bodyweights of the dogs at the beginning of the 8-day period that they received this diet were compared with those at the end of this period (students paired T-test), the bodyweight of the dogs was found to be significantly lower during this period ($P < 0.05$). It is important to note that the quantities of the diet given to the adult dogs each day was that found to maintain the bodyweight of the animals when they received the base diet. Thus a diet that contained a notably lower nutrient content than the base diet would be expected to result in a decrease in body-

weight and one with a greater nutrient density would be expected to provoke an increase in bodyweight, especially in this study, when the dogs always consumed all of the diet given to them.

There is no upper limit in terms of ME content of dogfoods established by AAFCO, however, for diets that contain more than 4,000 kcal ME/kg DM, the contents of the other nutrients must be corrected to take into account the lower food intake that is expected to occur with these diets (AAFCO 2002). A total of four of the diets formulated for adult maintenance and eleven of those for growing dogs contained a EM content greater than 4,000 kcal ME/kg DM.

The nutrient profiles published by the AAFCO (AAFCO 2002) recommend that dogfoods destined for adult dogs at maintenance and growing dogs contain a minimum of 18 and 22% of crude protein, respectively (following correction for high dietary energy level – > 4,000 kcal/kg – when present). As not all of the protein in a diet is absorbed by the dog, AAFCO (2002) use the factor of 1.3 to take into account the average protein bioavailability, which corresponds to a protein digestibility of 77%. Therefore, a dogfood must contain a minimum of 13.8 or 16.9% digestible protein for adult dogs at maintenance or growing dogs, respectively. In the present study, the digestibilities of the protein in the dogfoods were within the ranges of 75.7-89.8% and 76.5-87.7% for the formulations for growing dogs and adults at maintenance, respectively (table 2). Only one of the dogfoods of each type had a protein digestibility lower than 77%, and in both cases, the total crude protein content of the diet was sufficiently high to give an adequate digestible protein content, even when corrected for the energy contents of diets which contained over 4,000 kcal ME/kg DM. All of the diets contained an adequate level of digestible protein, with the lowest value for diets for growing dogs being 19.8% and that for adult maintenance formulations being 14.8% following correction for energy density when necessary (table 3).

It is important to note that the ME requirements for dogs calculated in this study are average requirements, with the equation used being appropriate for adult dogs with a bodyweight up to 35 kg (NRC 1985). The exact ME requirements of an individual dog will depend on its age, activity level, body condition, hair (insulating conditions), environmental temperature, acclimatization, external environmental circumstances and psychological temperament (NRC 1985). Most of the recommendations as to the quantity of the dogfoods that should be fed to the animals presented on the packaging present a range of quantities to take into consideration these variations between dogs. However, the ME requirements of the dogs calculated using the NRC equation can be considered to be average requirements. The present study evaluated whether this average ME requirement would be fulfilled adequately if the dogs were fed quantities of dogfood within the ranges recommended on the packaging of each brand.

The results of the study reported here show that a significant proportion of the dogfoods tested present recommendations on the packaging that would either over- or under-feed the dogs, with some recommended feeding quantities presenting amounts of ME that were very different from the dog's requirements. Feeding the dogs these quantities of the dogfoods may result in dogs that are significantly over- or under-weight. It is important that the manufacturers in many cases reconsider the manner in which these quantities are determined.

From the dog-owner and veterinary point of view, this study highlights the importance of adjusting the quantities of dogfoods that should be fed according to the body condition of the dog, with the aim of maintaining the dog with a body condition of 3 (scale 1-5).

SUMMARY

The objective of the study was to determine the quantity of metabolizable energy (ME) in the dogfood amounts recommended by the manufacturers for commercial dry dogfoods formulated for adult dogs at maintenance and growing dogs, and compare these with the dogs' calculated ME requirement. Commercial dry dogfood formulations for adult dogs at maintenance (15 brands) and growing dogs (15 brands) were evaluated. Samples from 3 batches per formulation were combined, ground and mixed with the indigestible marker Cr_2O_3. Each dogfood formulation for adult dogs was fed to 8 Labrador Retriever adult dogs and each formulation for growing dogs was fed to 8 growing Labrador Retriever dogs, for 8 days following 8 days in which the dogs received a nutritionally adequate base diet. Faecal samples were collected from each dog on days 6, 7 and 8 in which they received the test diets. The ME content of each diet was estimated and the quantity of ME in the amounts of the diets recommended by the manufacturers for adult dogs (10, 20 and 30 kg bodyweight) and growing dogs (12 and 24 kg bodyweight) was compared with the calculated ME requirements of these dogs. Depending on the size of the dogs, up to 80% of the brands recommended quantities of dogfood that would not supply the correct amount of ME according to the dog's requirement. Feeding the dogs these quantities of the dogfoods may result in dogs that are significantly over- or under-weight.

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