

Energy Quality of Dog Feeds and Owner Feeding Practices: Links to Body Condition Score

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The study aimed to evaluate the energy quality of complete commercial dog feeds by comparing declared metabolisable energy (ME) values with those determined by laboratory analysis. A total of 19 dry complete commercial dog feeds formulated for adult dogs in maintenance were analysed. Gross energy (GE) was measured by direct calorimetry and recalculated to ME using a conversion coefficient of 0.82. In addition, a questionnaire survey among 32 dog owners was conducted to assess feeding practices and their association with body condition score (BCS). The results showed that declared ME concentrations ($15,870 \pm 720$ kJ/kg) were on average higher than the recalculated values ($14,800 \pm 1,030$ kJ/kg), with a mean difference of $1,070 \pm 1,350$ kJ/kg. For a 15 kg model dog, this discrepancy translated into daily intake variations of several hundred kilojoules, potentially leading to under- or overfeeding. The questionnaire confirmed that 75% of owners provided treats and 72% used dietary supplements, both of which significantly increased total energy intake. Pearson correlation analysis demonstrated strong positive associations between BCS and the use of treats ($r = 0.71, P < 0.01$) as well as supplements ($r = 0.69, P < 0.01$), whereas the amount of complete feed alone showed no significant effect ($r = 0.31, P > 0.05$). These findings underline the importance of precise feed labelling and highlight the role of owner behaviour as a determinant of canine body condition. Improvements in transparency of nutritional information and targeted owner education are essential to support optimal feeding strategies and prevent obesity in dogs.

Keywords: metabolisable energy, dog nutrition, direct calorimetry, feeding practices, body condition score

1 Introduction

1.1 Background

Nutrition is one of the most important factors influencing the health and quality of life of dogs. The choice of suitable feed depends not only on nutrient composition but also on its energy value. Manufacturers declare metabolisable energy (ME) values on pet food labels to guide owners in correct rationing. However, the accuracy of these values is questionable, as laboratory analyses may reveal differences between declared and actual energy content. ME represents the energy that a dog can utilize after accounting for fecal, urinary, and gaseous losses, and its precise determination is essential for meeting nutritional requirements and preventing health problems such

as undernutrition or obesity (NRC, 2006; AAFCO, 2015). Obesity is currently considered one of the most serious nutritional problems in dogs, associated with metabolic disorders, diabetes, and orthopedic complications. Feeding behaviour of owners, including the frequent use of treats and dietary supplements, may further affect the real energy intake of dogs and complicate adherence to manufacturer recommendations (WSAVA, 2021; Sanderson, 2023). Previous studies have shown that owner perception of obesity, feeding habits, and lifestyle are strongly associated with canine body condition score, and that owner overweight status itself represents a significant risk factor for canine obesity (German et al., 2018; Montoya-Alonso et al., 2022).

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Although *in vivo* feeding trials are considered the gold standard for establishing metabolisable energy (ME), they are costly and predictive approaches are therefore widely used in practice (Jewell et al., 2023). Direct calorimetry (bomb calorimetry) provides an objective determination of gross energy (GE), which can be used to improve estimates of ME in pet foods and to evaluate the accuracy of declared energy values (Rolinec et al., 2016; Hall et al., 2013; Marchi et al., 2025). Consequently, combining laboratory-based energy evaluation with an assessment of owner feeding practices allows a more comprehensive understanding of both product-related and behavioural drivers influencing canine body condition.

1.2 Objectives and Hypothesis

The present study focused on the analysis of selected complete dry dog feeds. Gross energy was determined by direct calorimetry and recalculated to ME, which was then compared with manufacturers' declared values. In addition, a questionnaire survey among dog owners was conducted to evaluate feeding habits, including the use of treats and supplements, and their relationship with body condition score (BCS). The primary objectives were:

- to compare calculated ME values with declared values,
- to assess the association between additional energy intake from treats or supplements and BCS.

It was hypothesised that declared ME values would differ from laboratory-determined ME, and that the inclusion of treats and supplements would be positively associated with higher BCS.

2 Material and Methods

2.1 Feed Samples

In total, 19 commercially available complete dry dog feeds were analysed. Samples were purchased from retail market in Slovakia and represented different brands. Selected feeds were formulated for adult dogs in the maintenance stage, without special claims (growth, reproduction, senior, or medical diets). All feeds were stored under standard conditions as recommended by the manufacturer until analyses.

2.2 Calorimetric Analysis

Gross energy (GE) was determined using an isoperibolic calorimeter (LECO AC500, USA). Each sample was ground, homogenised, and combusted according to the manufacturer's instructions. Gross energy values were subsequently recalculated to metabolisable energy (ME) using a conversion coefficient of 0.82 (82%), reflecting average energy losses during digestion and metabolism in dogs, as described by Case et al. (2010) and supported

by experimental data on energy digestibility of extruded dog foods (Hervera et al., 2007) and nutritional guidelines (NRC, 2006).

2.3 Declared ME Values

The declared ME values were taken directly from the product labels or technical sheets provided by manufacturers. These values served as a reference for comparison with the laboratory-determined ME.

2.4 Model Dog and Daily Energy Requirement

The accuracy of feeding recommendations was assessed using a model adult dog with a body weight of 15 kg, representing a typical medium-sized dog maintained under maintenance conditions, as commonly applied in nutritional feeding guidelines (FEDIAF, 2022). Daily metabolisable energy (ME) requirements were calculated according to established nutritional guidelines (NRC, 2006; AAFCO, 2015) and compared with daily energy intake derived from declared and recalculated ME concentrations of the analysed feeds.

2.5 Questionnaire Survey

A questionnaire survey was conducted among 32 dog owners to obtain complementary information on practical feeding conditions in dogs fed complete dry food. The questionnaire was distributed in printed form and completed anonymously by voluntary respondents.

The survey consisted of 9 questions, predominantly closed-ended (e.g., yes/no or multiple-choice options), with some questions allowing respondents to provide additional specification. The questionnaire focused primarily on feeding practices, including the type of complete feed used, feeding trends related to complete dry diets such as following package instructions and recommendations for feed amount per dog weight, and the administration of treats and dietary supplements. In addition, respondents provided basic information about their dogs, such as age, body weight, sex, activity level, and body condition score (BCS). Body condition score was evaluated using a 1 to 9-point scale, where a score of 5 represented optimal body condition. The collected data enabled assessment of real-life feeding habits and their potential association with BCS. The questionnaire was originally administered in Slovak.

2.6 Statistical Analysis

Data were processed using SAS Enterprise Guide 7.1 (SAS Institute Cary, NC, USA). Differences between declared and calculated ME values were evaluated using a paired *t*-test. Pearson correlation analysis was applied to assess relationships between BCS and selected feeding practices (amount of feed, treats, supplements). Statistical significance was considered at $P < 0.05$.

3 Results and Discussion

3.1 Energy Values of Feeds

The analysis of 19 complete commercial dry dog feeds revealed differences between declared and calculated metabolisable energy (ME) values. On average, the ME declared by manufacturers was 15,870 ±720 kJ/kg, while the recalculated ME based on gross energy (GE) determined by direct calorimetry was 14,800 ±1,030 kJ/kg. The average discrepancy was 1,070 ±1,350 kJ/kg. Although some feeds showed only minor deviations, others exhibited more pronounced differences, indicating inconsistency in labelling accuracy.

Table 1 Average declared and calculated metabolisable energy (ME) concentrations in analysed complete dry dog feeds ($n = 19$)

Parameter	Mean ±SD (kJ/kg)
Declared ME	15,870 ±720
Calculated ME (from GE)	14,800 ±1,030
Difference (Declared – Calculated)	1,070 ±1,350

These discrepancies are nutritionally relevant, as even a difference of approximately 1,000 kJ/kg may substantially influence daily rationing for dogs. If maintained over a longer period, underestimation of energy could result in insufficient energy intake and loss of body condition, whereas overestimation could contribute to excessive intake and risk of obesity. Similar observations have been reported in the literature, where inaccuracies in declared ME values have been considered a potential source of feeding errors (NRC, 2006; Case, 2010).

3.2 Daily Intake for the Model Dog

The accuracy of feeding recommendations was further evaluated using a model adult dog with a body weight of 15 kg, representing a medium-sized dog maintained under maintenance conditions. According to established nutritional guidelines (NRC, 2006; AAFCO, 2015), the daily metabolisable energy (ME) requirement of such a dog is approximately 4,400 kJ/day. For each analysed feed, the daily ration for the model dog was calculated based on the manufacturer's feeding guidelines provided on the product label. When feed rations were calculated using the declared ME concentrations of the analysed feeds, the estimated daily energy intake was higher than that obtained from rations calculated using recalculated ME values derived from laboratory analysis. The results are summarised in Table 2.

The discrepancies demonstrate that the estimation of daily intake is sensitive to whether declared or

laboratory-determined ME values are used. Although the average difference may appear moderate, such deviations can accumulate over time and potentially contribute to underfeeding or excessive energy intake. This highlights the importance of precise nutritional labelling and the need for reliable values when formulating feeding recommendations for companion animals.

Table 2 Comparison of daily energy intake for a model dog based on declared and recalculated ME values ($n = 19$)

Parameter	Mean ±SD (kJ/day)
Requirement (NRC/AAFCO guidelines)	4,400
Intake calculated from declared ME	4,560 ±210
Intake calculated from recalculated ME	4,240 ±310
Difference (between declared ME – recalculated ME)	320 ±250

3.3 Owner Feeding Practices

The questionnaire survey among 32 dog owners revealed that most respondents regularly provided their dogs with additional sources of energy beyond complete dog feeds. A total of 75% of owners reported frequent use of treats, while 72% supplemented the diet with various additives such as oils, vitamins, or mineral preparations. Only a minority of owners (28%) fed exclusively complete commercial diets without additional supplements. These findings are consistent with previous reports indicating that owner feeding practices, together with misperception of body condition score, play an important role in inappropriate energy provision and the development of overweight and obesity in companion dogs (Muñoz-Prieto et al., 2018; Liyanage et al., 2022).

Overall, these results highlight the significant influence of owner behaviour on the actual daily energy intake of dogs. Even when complete feeds are formulated to meet nutritional requirements, additional calories from treats and supplements may substantially alter the total energy balance. Similar discrepancies between recommended and actual energy intake have been emphasised in current nutritional guidelines (WSAVA, 2021; Sanderson, 2023).

3.4 Correlation Analysis

Pearson correlation analysis confirmed strong positive associations between owner feeding practices and the body condition score (BCS) of dogs. The use of treats was significantly correlated with higher BCS ($r = 0.71, P < 0.01$), and a similar trend was observed for the addition of dietary supplements ($r = 0.69, P < 0.01$).

In contrast, the amount of complete commercial feed provided alone did not show a statistically significant relationship with BCS ($r = 0.32, P > 0.05$). The results are summarized in Table 3.

Table 3 Correlation coefficients (r) between feeding practices and body condition score (BCS) of dogs ($n = 32$)

Variable	r	P -value
Use of treats	0.71	< 0.01
Use of dietary supplements	0.69	< 0.01
Amount of complete feed	0.31	> 0.05

These findings highlight that additional feeding practices, particularly treats and supplements, represent more influential determinants of canine body condition than the quantity of complete feed alone, which is typically formulated to meet maintenance energy requirements when used according to feeding guidelines (Rolinec et al., 2016). Such behaviour may explain the frequent occurrence of overweight and obese dogs despite owners reporting adherence to recommended feed amounts, which is consistent with previous reports on the high prevalence of obesity and nutritionally driven metabolic imbalance in companion animals (German, 2006; Laflamme, 2008; Harčárová et al., 2025; Mihok et al., 2021).

This supports the view that managing caloric extras is crucial for maintaining optimal body condition and should represent a primary focus of nutritional education for dog owners. Similar conclusions were reported by German (2006), who highlighted the contribution of caloric extras to the prevalence of canine obesity, and by Dodd et al. (2021), who identified treats and supplements as major sources of unaccounted energy intake in companion animal diets.

3.5 Overall Implications

The combined results of laboratory analyses and the owner questionnaire underline the multifactorial nature of ensuring adequate canine nutrition. Discrepancies between declared and laboratory-determined metabolisable energy (ME) values of complete commercial feeds indicate that inaccuracies in energy labelling may affect practical rationing. Even moderate deviations in energy concentration per kilogram of feed may alter calculated daily portions and, over time, contribute to nutritional imbalance. At the same time, owner feeding behaviour substantially modifies the actual energy intake of dogs. The widespread provision of treats and dietary supplements, both strongly associated with higher body condition score

(BCS), demonstrates that feeding practices may outweigh the role of complete commercial feed alone in shaping overall energy balance.

From a practical perspective, these findings highlight two key challenges in companion animal nutrition. First, feed manufacturers should ensure transparent and reliable information on energy content to support accurate rationing. Second, veterinarians and nutrition specialists should place greater emphasis on owner education, addressing not only feed selection but also the cumulative impact of caloric extras on long-term energy balance. Together, these measures may help reduce the risk of overfeeding and obesity and promote healthier feeding strategies in companion dogs.

Canine obesity is a recognised metabolic disorder associated with multiple adverse health outcomes, and previous studies have identified treats and table scraps as common contributors to excessive energy intake (German, 2010; Dodd et al., 2021). In line with earlier observations (Laflamme, 2008), the present results suggest that even relatively small inaccuracies in energy estimation or feeding practices may, when sustained over time, significantly influence body weight and overall health in dogs.

4 Conclusions

This study highlights the need for more accurate energy labelling of complete commercial dog feeds, as discrepancies between declared and measured values may impair rationing. Owner feeding behaviour, especially the use of treats and supplements, was identified as a key factor affecting body condition. Both aspects should be considered in order to improve nutritional recommendations and support healthier feeding strategies in dogs. Future research should focus on validating these findings in larger populations and developing practical strategies to improve owner compliance with feeding guidelines.

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Conflict of Interest

The author declares no conflict of interest.

Author Contributions

Ester Vargová: Conceptualization, Methodology, Software, Writing – original draft. Michal Rolinec: Conceptualization, Methodology, Validation, Writing – review & editing. Branislav Gálik: Supervision, Project

administration, Funding acquisition. Miroslav Juráček: Supervision, Validation. Milan Šimko: Supervision. Ondrej Hanušovský: Formal analysis, Software, Resources. Matúš Ďžima: Formal analysis, Software, Resources. Kristína Kolbaská: Formal analysis, Software, Resources. Ela Tarišková: Formal analysis, Software, Resources.

AI and AI-Assisted Technologies use Declaration

The author used ChatGPT (OpenAI) to improve English grammar. The author takes full responsibility for the content of this article.

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