Metabolizable Energy and Caloric Density

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Understanding metabolizable energy (ME) is essential in determining the nutritional quality of your pet's food and comparing pet foods. ME is defined as the amount of energy available from pet food once the energy lost in the feces, urine, and combustible gases has been subtracted. Essentially, ME is the energy left for your pet's body to use once all digestion is complete.

To live a healthy, happy life your pet needs a certain number of calories per day. This will vary with the breed, age, sex, activity level, body condition, and other characteristics of your pet. ME, as shown on pet food packages, shows the amount of calories the food will provide your pet. Look on the package for a statement of calorie content, expressed as "ME (kcal/kg) = ##," where ## will be a number, such as 3500. You should also see a number of calories per cup or per can, depending on whether the food is dry or canned.

ME essentially equals the usable calories and their concentration, or density. A higher ME indicates a higher concentration of calories, and a more energy-packed food. This can be compared to the difference between a sports energy bar and a rice cake. The energy bar has a much higher ME, because it contains concentrated calories for energy. Similar to an energy bar, pet foods with higher ME numbers provide your pet's body with more concentrated calories for more energy. With a higher ME, your pet's body will receive more energy from a smaller amount of food. This also means he will eliminate less as waste, giving you less waste to clean up. Pet foods with a higher ME can also save you money in the long run since you can feed less while still providing the needed calories to fulfill your pet's nutritional needs.

Calculating ME

ME can be determined using feeding trials or through mathematical calculations.

Feeding trial method: The amount of ME in a food depends upon the type and digestibility of the ingredients that supply the calories. ME can be accurately determined by using feeding trials. The gross energy (GE) of the food is determined in the laboratory, and the amounts of food eaten by the animals are recorded. The feces and urine from the animals are collected, and the energy in each is determined and called fecal energy (FE) and urinary energy (UE), respectively. The energy lost in gases from a carnivore is generally considered negligible and not included in the ME determination. ME is then calculated as:

$$\textbf{ME (kcal/kg)} = \frac{\textbf{GE – FE – UE}}{\textbf{Kg of food consumed}}$$

Mathematical calculation method: Energy can be supplied by fat, protein, or carbohydrates. In general, fats in typical commercial pet foods are more digestible than carbohydrates, and carbohydrates more digestible than protein. Their average digestibilities have been determined through multiple trials. The energy value of these nutrients has also been determined through repeated testing. A value, called the Atwater Factor, can be determined by multiplying the % digestibility times the energy value.

Nutrient	% Digestibility	Energy Value (kcal/gm)	Atwater Factor
Fat	90%	9.4	8.5
Protein	80%	4.4	3.5
Carbohydrate*	84%	4.15	3.5

* The carbohydrate for these determinations is called the NFE, or nitrogen free extract. Nitrogen free extract is basically what remains after the moisture, protein, fat, fiber, and minerals (ash) have been removed from the food.
NFE = 100% - % moisture - % crude protein - % crude fat - % crude fiber - % ash.

To calculate the ME, the % of fat, protein, and carbohydrate in the pet food are then multiplied by their respective Atwater

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Factors, added together, and multiplied by 10.

ME (kcal/kg) = 10[(3.5 x CP) + (8.5 x CF) + (3.5 x NFE)]

Where ME = Metabolizable Energy

CP = % crude protein

CF = % crude fat

NFE = % nitrogen-free extract (carbohydrate)

For example, for a dry dog food that has:

- Moisture = 10%
- Crude Protein = 24%
- Crude Fat = 14%
- Crude Fiber = 4%
- Ash = 6%
- NFE = 42%

ME = 10[(3.5 x 24) + (8.5 x 14) + (3.5 x 42)]
= 10 x (84 + 119 + 147)
= 10 x 350
= 3500 kcal/kg

Because this Atwater calculation method uses averages, it will underestimate the ME content of foods that are highly digestible, and overestimate those than have less than average digestibility.

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