Nutrition for Working and Service Dogs

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KEYWORDS

• Nutrition • Glycolysis • Fat • Protein • Glycogen repletion • Omega-3 fatty acids

KEY POINTS

- Sprinting dogs require a balanced moderate protein, fat, and carbohydrate diet for optimal performance.
- Endurance dogs (hunting and patrol dogs working more than 1.5–2 hours a day) require higher-fat diets to fuel mitochondrial biogenesis and to enhance oxidative phosphorylation capacity.
- High-intensity repeated exercise over a moderate duration (ie, agility and field trial/hunt test dogs) benefits from postexercise carbohydrate supplementation.
- The geriatric athlete with degenerative joint disease should receive supplemental dietary long-chain omega-3 fatty acids.

INTRODUCTION

Conformation, genetics, and behavioral drive are the major determinants of success in canine athletes, although controllable variables, such as training and nutrition, play an important role. The scope and breadth of canine athletic events has expanded dramatically in the past 30 years, but with limited research on performance nutrition. However, there are considerable data examining nutritional physiology in endurance dogs (eg, sled dogs) and in sprinting dogs (eg, racing greyhounds). Nutritional studies for more popular canine activities, such as agility, field trial, and detection, are rare. Therefore, application of translational principles from sled dogs and greyhounds to such activities is necessary. This article highlights basic nutritional physiology and interventions for exercise, and reviews newer investigations regarding aging working and service dogs, and canine detection activities.

THE ENERGETIC COST OF ACTIVITY

Exercise principally relies on ATP derived from the use of substrates, such as carbohydrate, protein, or fat. The energetic potential of a diet is commonly reported in

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kilocalories (kcal) or kilojoules (kJ). Kilocalories, also referred to as calories, are equivalent to 4.16 kJ in the metric system. Metabolizable energy (ME), as reported on pet food labels, refers to the dietary energy remaining after factoring in energy lost in urine, feces, and gases. Current pet food regulations use the modified Atwater factors to estimate food energy, which assigns protein and carbohydrate an ME value of 3.5 kcal/g, and fat a value of 8.5 kcal/g.[1,2] However, the actual ME is principally determined by dietary fat, and by total dietary fiber content of a diet.[2] Because fiber not only dilutes calories in foods but also affects absorption of nutrients, it is not usually a significant concern when feeding athletic dogs, as little is incorporated into performance rations. Feeding trials are used to directly calculate the energetic potential of any given diet and are considered the gold standard.[2]

The National Research Council (NRC) has established energy requirements for dogs based on the available scientific literature.[2] A multiplication factor is applied to the exponential equation for metabolic body weight (MBW = [kg body weight]$^{0.75}$) to determine the energy expenditure of dogs in different conditions. The NRC estimates that active pet dogs require 130 × MBW kcal/d for maintenance energy requirements (MERs).[2] Overall, the active dog will typically require this amount of energy and, depending on the daily activity, these energy requirements will increase. In general, this can be minimally a 5% to 10% increase from the MER, as observed in greyhounds, up to an eightfold increase observed in racing endurance sled dogs. The effects of increasing physical activity and of training during treadmill exercise have been extensively studied in dogs. Such studies use indirect calorimetry, which determines caloric expenditure by measuring the rate of oxygen consumption. The maximum oxygen consumption during exercise (VO_2 max) reflects the maximal energy that can be generated via oxygen utilization in the mitochondrial electron transport chain; hence, is a direct correlation to the energy that can be generated for muscle activity. An average 20-kg foxhound or Alaskan sled dog working near VO_2 max requires approximately 700 to 900 kcal per hour of work based on the experimental conditions set forth in simulated treadmill exercise.[3–5] This caloric expenditure during exercise is directly related to the distance traveled. Therefore, the expected caloric needs for canine activities should be proportional to the distance of that activity, not the intensity of the exercise (Table 1). For example, whippet racing would

Table 1
The integrative energetic cost of selected common canine activities

Low (<25% Increase)[a]	Moderate	High (>100% Increase)[a]
Agility	Bikejoring (2–10 mi)	Sled dog racing (>20 mi)
Obedience or conformation	Carting (2–10 mi)	Bikejoring (>10 mi)
Disc dog	Field trials	Carting (>10 mi)
Dock jumping	Herding	Hunting (>3 h)
Greyhound racing	Hunting (<3 h)	
Earthdog	Search and rescue	
Low-activity service	Weight pulling	
Coursing	Sled dog racing (<20 mi)	
Flyball	High-activity service	

[a] The exercise amounts for many of these activities have not been reported. In general, short periods of activity, even if vigorous, have small effects on caloric requirements. The moderate and high categories depend greatly on the distance traveled and the ambient temperature. This is based on typical active dog lifestyle maintenance energy requirements of 132 (kg)$^{0.75}$.