Sodium – chloride, tripolyphosphate, or nitrite: do dogs really need salt?

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Tim Watson discusses the notion that dogs consume too much dietary sodium, and explains that its effect on human health may not apply to dogs

DIETARY salt is a big issue for those concerned with human health.

High intakes of salt – and specifically sodium – are a key factor in the development of hypertension, renal failure and coronary heart disease (Titze and Ritz, 2009). More than 75 per cent of salt consumed in industrialised countries comes from processed and restaurant foods (Dötsch et al, 2009) – consequently, food manufacturers are under pressure from international authorities to reduce salt levels by 20 to 30 per cent (Dickinson and Hava, 2007).

The majority of dogs in industrialised countries are fed prepared pet foods and, coupled with a tendency to assume that what is true for humans also applies to pets, this might encourage the notion that dogs consume too much salt. An extension of this notion is the concern that pet foods' sodium content might be detrimental to canine health.

This article reviews dogs' sodium requirements and considers how the sodium content of pet foods compares with these dietary requirements and the diets of wild dogs. Relationships between sodium intake and the risk of disease are examined, along with the extent to which salt affects food selection and the palatability of dog foods.

Canine requirements for sodium

Sodium is the tenth most abundant element in the body, making up just less than 0.2 per cent of a dog's bodyweight (Meyer et al, 1985). Along with chloride, it plays a key role in the maintenance of osmotic pressure and extracellular volume, acid-base balance, and conductivity in neural tissues.

Major dietary sources of sodium for dogs are meat and dairy products. Fruits and vegetables, including grains, contain little or no sodium (Figure 1).

Additional sources of sodium in pet foods include sodium chloride, sodium tripolyphosphate and sodium nitrite. Sodium chloride, or salt, is added to pet foods purely to ensure nutritional adequacy, because most food ingredients are naturally low in chloride. Sodium tripolyphosphate helps provide texture, and sodium nitrite preserves colour.

Dietary sodium is efficiently absorbed from the canine intestinal tract, with an overall apparent digestibility in excess of 95 per cent (Meyer et al, 1989; Hill et al, 2001). Absorption is, however, reduced in the presence of soyderived vegetable proteins (Hill et al, 2001), cellulose and other poorly digestible carbohydrates (Kienzle et al, 2001).

Clinical signs of sodium deficiency include restlessness, tachycardia, polydipsia and polyuria, dry and tacky mucous membranes and haemoconcentration (Drochner et al, 1976).

Dogs' minimum dietary requirement for sodium has been established at 5mg/kg bw/ day (Drochner et al, 1976; Morris et al, 1976). To provide a safety margin and account for dietary factors that might reduce the absorption of sodium, the National Research Council (NRC) recommends a minimum daily intake of 13.3mg/kg bw (NRC, 2006). This corresponds to a dietary sodium level of 0.2g/1,000 kcal of metabolisable energy (ME).

Higher minima are recommended for bitches during gestation and lactation (0.5g/1,000 kcal), as well as in growing puppies (0.55g/1,000kcal) and dogs, such as greyhounds and sled dogs, that undertake more than average amounts of exercise (1.0g/1,000 kcal; NRC, 2006).

Sodium content of dog foods

Commercially available dog foods provide sodium intakes comfortably in excess of minimum requirements. Products for adult dogs typically contain between 0.5g/1,000 and 2.5g/1,000 kcal of sodium, which equates to 2-10g/kg dry matter (DM).

Dry dog foods generally contain less sodium than wet foods (canned, tray or pouch), reflecting their lower content of sodium-rich meat and meat products: dry foods typically contain 20 per cent meat compared with up to 60 per cent in wet foods. Wheat and maize (corn) – two common ingredients of dry dog foods – contain 0.10g/kg DM and 0.35g/ kg DM of sodium, respectively. According to NRC data, there is no difference between the sodium content of mainstream and premium brands of dog food (Figure 2).

The sodium content of prepared dog foods is similar to that of prey consumed by wild dogs. Common prey species, which include newborn calves, whitetailed deer, rabbits and chickens, contain between 2.5g/kg DM and 10g/kg DM of sodium (Dierenfeld et al, 2002).

Certain human foods – especially processed foods such as bacon, sausages and hard cheeses that may be offered to dogs as treats or in the form of table scraps – contain sodium levels in excess of those found in prepared dog foods, with values of between 10g/kg DM and 18g/kg DM (Figure 3).

Salt and dog foods' palatability

The taste of salt is innately appealing to people – hence its use as a flavour enhancer – but dogs' and cats' taste systems are not the same as that found in humans and other omnivores. One of the major differences is that dogs are relatively insensitive to salt, showing little preference for sodium chloride or appetite for sodium (Fregly, 1980). Because of this, the palatability of dog foods is not enhanced by the addition of salt or sodium (Bradshaw, 2006). The idea that dog food palatability might be improved by adding salt (Delaney, 2006) is thus incorrect.

This inability of dogs to taste salt – and for salt not to be a driver of food selection and consumption – undoubtedly reflects evolutionary adaptation of dogs and cats as carnivores to preybased diets that naturally contain adequate levels of sodium. In contrast, the greater ability of omnivores and herbivores to taste salt is the means by which they are able to select from foods with low salt contents.

Sodium consumption and disease risk in dogs

Adverse effects from consuming diets containing large amounts of sodium include vomiting, increased plasma volume, increased excretion of potassium and a negative potassium balance (Morris et al, 1976; Zentek and Meyer, 1995; Reinhardt and Behrenbeck, 1967). These effects are seen when dietary sodium levels exceed 20g/kg DM; the NRC currently defines a safe upper limit for sodium of 15g/kg DM (NRC, 2006).

As salt toxicity is only seen at such high intakes, this indicates that healthy dogs are tolerant and adapt well to large fluctuations in sodium intake. The extent to which this is also true of dogs with underlying disease has been the subject of scrutiny (Chandler, 2008). To date, there is no evidence t h a t dietary sodium levels correlate with blood pressure in healthy dogs, or those with renal failure (Langston et al, 1963; Greco et al, 1994) or cardiac disease (Rush et al, 2000).

Furthermore, there is no indication that excessive salt intakes contribute to progression of kidney or heart disease – although, in one study, dogs with congestive heart failure were found to consume more sodium than dogs with symptomatic cardiac disease (Freeman et al, 2003).

The lack of any impact of high sodium intakes on hypertension, renal failure or cardiac disease in dogs is not simply because they consume less salt than humans. Average daily consumption of salt by people is remarkable consistent at 8.8g, corresponding to 3.5g of sodium (Aldermann, 2006). This means that a 70kg person typically consumes 50mg/kg bw of sodium a day whereas, in comparison, a 15kg dog consumes between 30 and 200mg/kg bw.

Owners of dogs with cardiac disease, especially those with congestive heart failure, are often advised to restrict sodium intake in the belief this will reduce fluid retention and lessen the load on the heart. This is just one of several nutritional modifications that may benefit dogs with cardiac disease (Freeman, 1998).

Although there are limited, and sometimes conflicting, data on the clinical benefits of sodium restriction, lowsodium diets have been associated with reductions in heart size and improvements in cardiac function in symptomatic (Rush et al, 2000) and asymptomatic (Freeman et al, 2006) heart disease.

Commercially available, sodium-restricted diets contain approximately 10 per cent of the sodium content of typical pet foods. The sodium content of some products is as low as 0.3g/1,000 kcal, which is close to the minimum of 0.2g/1,000 kcal recommended by the NRC (NRC, 2006).

Attention needs to be paid to the feeding of treats and table foods, especially sodiumrich processed meats and dairy products, since there is evidence these contribute around 25 per cent of the daily sodium intake in dogs with heart disease (Freeman et al, 2003).

There is a concern that high sodium intakes might increase urinary calcium excretion – because the two ions share a common reabsorption mechanism in the kidney – and hence raise the risk of calcium oxalate urolithiasis in dogs (Chandler, 2008).

Studies have, however, proven this is not the case and shown that adding sodium to the diet actually lowers the likelihood of calcium oxalate formation by promoting the formation of dilute urine with no net increase in calcium concentrations (Stevenson et al, 2003; Lulich et al, 2005).

Conclusions

Concerns that dog foods contain excessive amounts of salt, or that the levels of sodium found in these products are harmful to dogs, are unfounded. Salt is not added to dog foods to improve their palatability and, while it is true that sodium levels are higher in wet dog foods, this is simply a reflection of their ingredients.

From a clinical perspective, and in contrast to humans, there is no scientific evidence linking sodium intakes in dogs with increased risk of hypertension, renal or cardiac disease, or calcium oxalate urolithiasis.

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