WALTHAM VIEWPOINT

Effect of diet on relative supersaturations in canine urine

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SUMMARY

This study confirms that WALTHAM Canine S/O Control pHormula Diet™ (canned and dry):
- undersaturates urine with the components of struvite
- is safe for long-term feeding

This study also confirms that WALTHAM Canine S/O Control pHormula Diet™ (canned):
- undersaturates the urine with the components of calcium oxalate

Investigations into the effect of diet on urinary parameters in the dog have been conducted for many years. Struvite (magnesium ammonium phosphate) is the most common component found in canine uroliths and made up over 50% of canine uroliths submitted for quantitative analysis at the Minnesota Urolith Center, University of Minnesota. Diet is known to contribute to the management and prevention of recurrence of struvite uroliths, and research in this area has concentrated on:

- the effects of certain minerals
- the influence of diet on urinary parameters including pH, volume, and solute concentration
- the effect of urinary tract infection

With respect to struvite the most important difference between cats and dogs is that, in the dog, the formation of most struvite uroliths is closely linked to a concurrent urinary tract infection with urease-producing bacteria such as staphylococci and *Proteus* spp. The majority of feline struvite uroliths are, however, sterile. Hydrolysis of urea by the enzyme urease ultimately results in the formation of ammonia and carbonate, which creates an increasingly alkaline environment in the urine. These conditions are ideal for the formation of struvite uroliths but may also favor formation of other urolith types including calcium carbonate and apatite (1). Quantitative urine culture should therefore be carried out for any dog with suspected struvite urolithiasis. If found to be infection-induced, appropriate antimicrobial agents form an essential component of therapy for struvite urolithiasis in dogs. For medical dissolution of the urolith, antimicrobial treatment in conjunction with an acidifying diet should continue until at least 1 month after dissolution is complete. Where surgical removal of the urolith is necessary, treatment of the infection is required until quantitative culture results are negative. Dietary measures may also be beneficial in controlling struvite-associated urinary tract infections. Urea concentration in the urine is directly affected by the level of protein in the diet. A reduction in dietary protein intake, therefore, has a beneficial effect by reducing the amount of substrate available for bacterial growth.

The second most common urolith type found in the dog is calcium oxalate, which constitutes around 25% of canine uroliths. The formation of a calcium oxalate urolith is a complex process. This involves a group of disorders that disturb the balance of calculogenic materials (calcium and oxalate) and inhibitors of calcium oxalate crystal growth/agglomeration (such as citrate, magnesium, and phosphorus).

Struvite is the product of constituent ions of magnesium, ammonium, and phosphate, whereas calcium oxalate is the product of calcium and oxalate ions. When the urine concentration of the constituent ions is low, the urine is described as undersaturated. In this environment, crystals will not form and preformed crystals, if struvite, will dissolve. Calcium oxalate is a very insoluble mineral and is unlikely to dissolve even in undersaturated urine. As the concentration of ions increases, the urine becomes supersaturated and is termed the metastable zone, in which crystals do not spontaneously form but preformed crystals do not dissolve and may grow. As the ion concentration increases to oversaturation, spontaneous crystallization can occur with rapid crystal growth. Studies on the effect of diet on urinary saturation, thus provide a more critical appraisal of the likely beneficial or detrimental effects of manipulating nutrient profiles than does evaluation of pH alone.

Urinary relative supersaturation (RSS) and urine pH are routinely measured at the WALTHAM Centre for Pet Nutrition when assessing the effect of diet on urinary parameters in the dog. Studies have been conducted that have led to the development of a commercial diet available in both canned and dry format. Two panels of eight normal healthy adult dogs of mixed breed (Labrador retrievers, miniature schnauzers, and beagles) were fed these diets for 12 weeks twice daily at 08:30 h and 15:30 h. Food allowances were calculated individually based on maintenance energy requirements. During weeks 4, 8, and 12, cephalic blood samples were obtained for hematology, biochemistry and blood gas analysis. Throughout the trials, dogs were housed individually for 2 days in every 4 and urine pH was continuously measured using the WALTHAM noninvasive automated system **(Table 1)** (2). Once every 4 weeks urine samples were collected, frozen and analyzed as previously described (3).

A mean trial urine pH within the range of 5.5–6.0 and a struvite RSS of <1.00, as produced by both the canned and dry formats of this diet, would be considered ideal for the management and prevention of recurrence of struvite urolithiasis in the dog, assuming the appropriate antimicrobial therapy is administered if required. Additionally, the canned format of this diet produced a calcium oxalate RSS of <1.00 and thus would also be considered suitable for the prevention of recurrence of calcium oxalate formation. Blood parameters show that the level of acidification achieved by these diets is safe for long-term feeding and will not predispose dogs to metabolic acidosis.

Table 1

Urinary pH, relative supersaturations of calcium oxalate and struvite, and blood parameters produced by two diets* developed at the WALTHAM Centre for Pet Nutrition

Diet format	*Mean trial urine pH*	*Relative supersaturations (RSS)*		*Blood parameters*	
		Struvite	*Calcium oxalate*	*Blood pH*	*Blood HCO_3 (mmol/l)*
canned	5.80 ± 0.82	0.12 ± 0.20	0.87 ± 0.57	7.35 ± 0.04	22.91 ± 1.47
dry	5.75 ± 0.99	0.59 ± 0.59	2.84 ± 1.63	7.35 ± 0.07	23.09 ± 2.07

* PEDIGREE Low pH Control Diets

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