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Management of struvite uroliths in dogs

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Abstract

Urolithiasis is a common clinical problem in dogs. Struvite and calcium oxalate are the predominant mineral types in dog urolithiasis. The aim of the present study was to compare the effect of two commercial dry foods formulated for the management of struvite urolithiasis with different anion–cation balance on urinary pH. For the trial, twelve privately owned adult dogs showing struvite urolithiasis were studied. The dogs were randomly divided into two groups (A and B) and fed two dissolving diets for 3 months. The analyses of urine were repeated six times. In both diets, the anion–cation balance was negative (−203 and −192 for diets A and B, respectively). At the first urine analysis, pH values of all the dogs were close to 8·0, and bacteria were present in about 70 % of the samples and thus an antimicrobial was administered for 1 week. Both groups showed a progressive decrease in pH values, and after 2 months, in both cases, the recommended pH values for stone dissolution were achieved. From the sampling at 30 d, group A showed pH values significantly ($P < 0.05$) lower than group B, probably due to the lower anion–cation balance of diet A. The combination of antimicrobial and dietary therapy allowed the dissolution of struvite uroliths in both groups, even if the utilisation of the diet characterised by the lower anion–cation balance seems to decrease the urinary pH more rapidly. In this case, it seems necessary to interrupt the dietary treatment in order to avoid the risk of other diseases.

Key words: Urolithiasis: Struvite: Dogs: Anion–cation balance

Urolithiasis is a common clinical problem in dogs. Several risk factors for urolith formation, such as breed, sex, age, diet composition, water intake, infection of the urinary tract, environment and drug administration, have been recognised[1]. Struvite and calcium oxalate are the predominant mineral types in urolithiasis in dogs, representing, overall, more than 80 % of total reported urolithiasis cases[2,3].

The aim of the present study was to compare the effect of two different dry foods for the management of struvite urolithiasis with different anion–cation balance on urinary pH.

Materials and methods

A total of twelve privately owned adult dogs (4·3 (SEM 1·2) years old; live weight 20·2 (SEM 10) kg) of different breeds showing struvite urolithiasis, confirmed by urolith composition assay, were divided into two groups (A and B), and fed for 3 months one of two dry diets (Hill's prescription diet c/d named A *v.* an experimental diet named B) formulated in order to dissolve struvite uroliths. After the first evaluation (time 0), all the dogs were returned to their owner, and the following recommendations were specifically indicated: (1) increase the water administration in order to dilute the urine; (2) increase the outdoor time in order to promote the voluntary urination. The diets were analysed for chemical and mineral composition[4,5], and the anion–cation balance (mEq/kg DM) was calculated according to the equation proposed by Langendorf[6]:

$$49{\cdot}9 \times \mathrm{Ca} + 82{\cdot}3 \times \mathrm{Mg} + 43{\cdot}5 \times \mathrm{Na} + 25{\cdot}6 \times \mathrm{K} - 64{\cdot}6 \times \mathrm{P} - 62{\cdot}4 \times \mathrm{S} - 28{\cdot}2 \times \mathrm{Cl}.$$

Urine analyses were repeated six times (every 15 d). Urine was collected in the morning immediately after the food administration.

All procedures were approved by the Federico II Ethics Committee.

Data were processed using PROC GLM of Statistical Analysis Systems (SAS Institute, Cary, NC, USA)[7].

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Table 1. Chemical and mineral composition of the diets

Diets	A*	B*
CP (%)	21·7	19·5
EE (%)	19·6	19·0
CF (%)	2·70	1·50
Ash (%)	4·30	4·40
Ca (g/kg DM)	7·88	6·20
Mg (g/kg DM)	1·12	1·40
Na (g/kg DM)	3·67	3·35
K (g/kg DM)	7·50	7·93
P (g/kg DM)	9·61	8·63
S (g/kg DM)	5·76	5·43
Cl (g/kg DM)	7·50	7·51
Anion–cation (mEq/kg DM)†	−203	−192

CP, crude protein; EE, diethyl ether extract; CF, crude fibre.
* Hill's prescription diet c/d named A *v.* an experimental diet named B.
† Anion–cation balance calculated on the basis of food content in g/kg DM: mEq/kg DM = 49·9 × Ca + 82·3 × Mg + 43·5 × Na + 25·6 × K − 64·6 × P − 62·4 × S − 28·2 × Cl.

Table 2. Mean values of urinary pH and density (kg/m^3) registered for groups A (*n* 6) and B (*n* 6)
(Mean values with their standard errors)

	pH				Density			
	Group A		Group B		Group A		Group B	
Sampling day	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
0	8·0	0·5	8·0	0·8	1043	12·5	1045	13·3
15	6·7	0·7	6·9	0·9	1044	10·4	1045	11·2
30	6·3^b	0·5	6·6^a	0·4	1040	11·8	1042	10·3
45	5·8^b	0·4	6·1^a	0·4	1025	9·45	1031	12·1
60	5·7^b	0·5	6·0^a	0·3	1020	1·3	1022	10·1
75	5·6^b	0·5	5·9^a	0·5	1015	12·4	1023	12·5

^{a,b} Mean values within a row with unlike superscript letters were significantly different for diets A and B ($P<0·05$).

Results

The chemical and mineral composition of the diets is reported in Table 1. The chemical and mineral composition of both diets was appropriate for dissolving struvite uroliths[8,9]. In particular, the diets were characterised by moderate protein amounts in order to reduce urinary urea availability for urease-producing bacteria. The fibre contents were lower than in maintenance diets in order to improve the digestibility and to reduce water losses via faeces. Regarding mineral composition, both diets were characterised by low Mg and P supplementation. Although in both diets the anion–cation balance was negative, diet A showed an anion–cation balance lower than diet B. This was due to the differences in the amount of P, S and Mg.

The mean values of urinary pH and density registered during the trial are reported in Table 2. For urine analysed at the first time point, the mean pH values were 8·0 (SEM 0·5) and 8·0 (SEM 0·8) for groups A and B, respectively, and bacteria were found in about 70 % of the samples. For this reason, an antimicrobial (fluoroquinolones in tablet form) was given for 1 week. All urine samples analysed after 15 d did not show bacteria.

Both groups showed a progressive decrease in pH values. This could be affected to the chosen measuring time (each 15 d in the morning immediately after the food administration), instead individual urine pH changes during the day[10]. From the 30 d sampling, dogs fed diet A showed pH values significantly ($P<0·05$) lower than dogs fed diet B. This could be due to the lower anion–cation balance of diet A. After 45 d of therapy, in both cases, the pH values recommended for stone dissolution were on average 5·9–6·1[1]. From 45 d sampling, group A showed pH values lower than 5·9. The pH values, registered after 75 d of dietary treatment, indicated the necessity to change the diet in both cases in order to avoid the risk of other diseases (e.g. urate urolithiasis[1]). At the end of the trial, none of the urine samples showed crystals as has been reported in other studies[11,12].

Conclusion

The combination of antimicrobial and dietary therapy allowed the dissolution of struvite uroliths in both groups, even if the utilisation of the diet characterised by the lower anion–cation balance seems to reduce the urinary pH more rapidly.

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The authors' contributions were as follows: S. C. and R. T. performed the chemical and mineral analysis of the diets. S. B. and M. I. C. chose the diets and calculated the individual

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