

UROLITHIASIS IN GUINEA PIGS – NUTRITIONAL ASPECTS

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Introduction

Food chain element transport has always been a major source of certain physiological phenomena (Kádár et al. 2004; Svetková et al. 2005)). Stone formation is a common phenomenon in mammals, and urinary calculi are common findings in guinea pigs (*Cavia porcellus*) as well, although the prevalence in guinea pigs has not been established. Struvit uroliths and calcium-containing uroliths like calcium carbonate, calcium phosphate, and calcium oxalate are detected in this species (Hamel, 1994). During 7 years, 20 pet guinea pigs (15 female, 5 male) with urethral or bladder calculi were seen at the Hannover Veterinary School (Fehr and Rappold, 1997). The mean age of these animals was 4.6 years. The calculi were removed surgically. Calcium carbonate was present in 18 calculi, calcium phosphate in 12 and calcium oxalate in 3.

The initial step of urolith formation is the formation of a crystal nidus. This can happen when supersaturation of urine with urolith forming crystalloids occurs, or when preformed organic matrix (possibly a mucoprotein with Ca-binding properties) forms an initial nucleus that subsequently permits urolith formation by precipitation of crystalloids. The presence or absence of crystallisation-inhibiting factors may also influence the formation of a crystal nidus.

Urinary pH has a profound effect on the solubility of some urolith compounds. Struvit uroliths, calcium carbonate and calcium phosphate are more soluble when the pH is acidic. As the urine of herbivores is commonly alkaline, the uroliths are mostly acid soluble.

Veterinarians are often asked for diet plans for rabbits or guinea pigs suffering from urolithiasis. As urine specific gravity and urine pH are parameters which significantly influence the solubility of the different urolith forming minerals, the aim of this trial was to evaluate the impact of various nutrients on these parameters in guinea pig urine.

The aim of the trial was to evaluate the impact of various nutrients on stone formation. Specific gravity and pH-value of the urine are parameters which highly influence crystallization.

Material and methods

The different rations were tested on 16 female guinea pigs, aged 2.5 years in a consecutive manner. Prefeeding period took 9 days; urine collection period lasted 5 days. Urine volume, specific gravity and pH were determined daily within the 5 days collection period. For the determination of the mineral content (calcium, magnesium, phosphorus) the urine of the 5 days period was collected and mixed.

On one hand the influence of water containing feed was tested (salad, carrots, apples), on the other hand feed (pellets; 90 % dry matter) supplemented with methionine (3.5, 5.5, 7.5, 9.9 and 11.5 g/kg) was used in this trial. No vitamin C was added to this methionine supplemented pellets. Control feed consisted of hay + “Bunny Vollwertkost für Meerschweinchen“(54329 Kunz, Germany; 600 mg vitamin C/kg). The guinea pigs received 30 g hay/day plus the specific feed ad libitum. Furthermore, vitamin C-supplemented water was offered (10 mg/100 ml).

Data are expressed as means and standard deviations (SD). The variables were evaluated using the Kolmogorov-Smirnov method in order to assess their normal distribution. Within the groups, all variables showed normal distribution. The differences between the groups were calculated with help of the Scheffé procedure. The correlations (water intake, amount of urine, specific gravity) were measured using Spearman method. The selected level of significance was $p < 0.05$. Statistical evaluation was done by ANOVA-analyses.

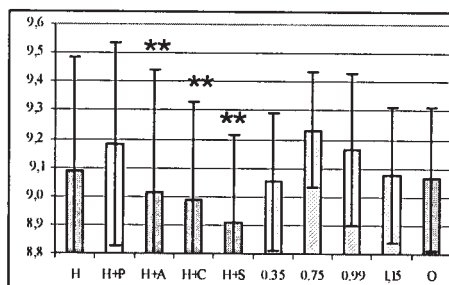


Figure 1.

pH value of guinea pigs' urine

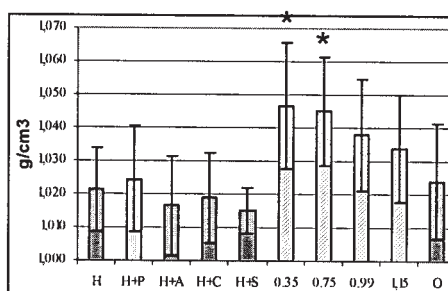


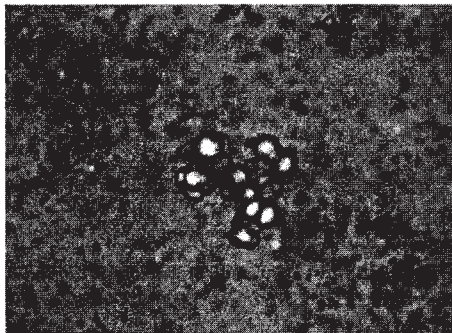
Figure 2.

Specific gravity of guinea pigs' urine

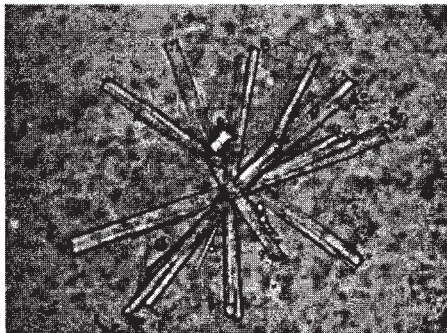
Legend: H= hay; H+P= hay + bunny=control; H+A=hay + apple; H+C=hay + carrots; H+S=hay + salad; 0.35=hay + pellets containing 0.35 % methionine; 0.75= hay + pellets containing 0.75 % methionine; 0.99= hay + pellets containing 0.99 % methionine; 1.15= hay + pellets containing 1.15 % methionine; H+O=hay + oats. *= $p \leq 0.05$; **= $p \leq 0.001$ compared with the control, respectively.

Results

The results obtained suggest, that rations containing hay and fresh feed entail increased urine volume, decreased pH values (Figure 1) and urine specific gravity (Figure 2). Methionine premixes had no beneficial impact on any of the urine parameters observed. The excretion of calcium with the urine differed between the individuals as well as between the groups. The amount of phosphorus excreted within 5 days was 39 mg (SD=28) when hay and pellets were given, 42.5 mg (SD=17) when pellets containing 3.5g/kg methionine were fed, 43 mg (SD=18) and 70.5 mg (SD=34) when pellets with 5.5. and 7.5 methionine/kg were fed, respectively. The urine volume was between 105.9 ml/day (SD=76.5) when apples and hay were given and 32.2 ml/day (SD=27.2) with 7.5 g/kg methionine containing pellets were fed. Compared with the control feed (hay and pellets), the fresh feed increased the urine volume whereas the methionine containing pellets significantly decreased the urine volume.

**Photo 1**

Calcium carbonate crystal

**Photo 2**

Calcium phosphate crystal

Photos from the courtesy of the
Zentrallabor, Veterinärmedizinische Universität Wien, Austria

Conclusions

As expected, green fodder materials contribute to abundant urine production of guinea pigs and as a consequence of that to a lower urinary specific gravity. pH values were significantly less alkaline when fresh feed was given compared with the control diet (hay + bunny), possibly caused by the vitamin C-content of this fresh feed. Vitamin C-intake was highest when salad was given (mean salad intake 142 g/day, SD=23; vitamin C-content 13 mg/100g salad according to Souci, 2000). Methionine had no effect on urine pH. In conclusion guinea pigs should be fed hay and fresh feed to minimise the risk of urolith formation on the one hand with the benefit of preventing adipositas, the most common problem in this pets.

References

- Asek, T.; Serman, V.; Mikulec, Z.; Mas, N. (2003): Physiological characteristics of rabbit nutrition. *Krmiva* 45, 293-299 pp
- Fehr, M.; Rappold, S. (1997): Harnsteinbildung bei 20 Meerschweinchen. *Tierärztliche Praxis* 5, 543-547 pp
- Hamel, I. (1994): Das Meerschweinchen als Patient. Gustav Fischer, Stuttgart.
- Hand, M.S.; Thatcher, C.D.; Remillard, R.L.; Roudebush, P. (2000): Small animal clinical nutrition. 4th ed., Walsworth, Marceline, Missouri, 943-960 pp
- Isenbügel, E.; Frank, W. (1984): Heimtierkrankheiten. Ulmer, Stuttgart, 62 p
- Kádár, I.; Lukács, D.; Fekete, S.; Bana, K. (2004): Tápanyagellátás hatása a szója minőségére és elemfelvételére (Impact of plant nutrition on the quality and element transport of soybean – in Hungarian). *Agrokémia és Talajtan*. 53. 1-2. 93-110 pp
- Kienzle, E.; Schuhknecht, A. (1993): Struvite stone dietetics: 1. Effect of different feed rations on the urine pH-value of cats. *Dtsch. Tierärztl. Wochenschr.* 100, 198-203 pp
- Kraft, W.; Dürr, U.M. (1997): Klinische Labordiagnostik in der Tiermedizin. 4th ed., Schattauer, Stuttgart.
- Loeb, W.F.; Quimby, F.W. (1999): The Clinical Chemistry of Laboratory Animals. 2nd ed., Taylor & Francis, appendix 661 p
- Meyer, H.; Coenen, M. (2002): Pferdefütterung. 4th ed., Parey, Berlin, 30 p
- Remillard, R.L.; Modransky, P.D.; Welker, F.H., Thatcher, C.D. (1992): Dietary management of cystic calculi in a horse. *J. Equine Vet. Sci.* 12, 359-363 pp
- Sgrulletta, D., De Stefanis, E., Scalfati, G., et al. (2004): Variability of dietary fibre content (TDF and B-glucan) for oat cultivars (*A.sativa* s.p.) in low input growing conditions *Cereal Res. Commun.* 32 (1): 127-134 pp
- Souci, S.W.; Fachman, W.; Kraut, H. (2000): Food composition and nutrition tables. 6th ed., Medpharm Scientific Publishers, Stuttgart.
- Svetková, K.; Henselová, M.; Morvová, M. (2005): Effects of a carbonization product as additive on the germination, growth and yield parameters of agricultural crops. *Acta Agron. Hun.* 53. 3. 241-250 pp