Rabbits have a very unusual calcium metabolism. In cats and dogs, calcium absorption is regulated at gut level, and is adjusted according to the body’s requirements. Any excess dietary calcium passes through and is excreted in the faeces. However, in rabbits, calcium absorption appears to be less well regulated, and indeed appears to be proportional to dietary calcium levels, irrespective of requirements. Excess absorbed calcium is therefore excreted through the urinary tract, often resulting in urine high in calcium precipitate. Sludge in the bladder can result in discomfort and disease in predisposed animals.

Pre-disposing Factors for Urolithiasis

- Unusual calcium metabolism
- High dietary calcium levels
- Urine pH and solubility of Ca salts
- Obesity, limited exercise
- Infection
- Low water intake

Early Indicators of Disorder / Disease

- Behavioural changes - depression, tooth grinding (pain), reluctance to be handled
- Appetite – reduced or anorectic
- Posture - tucked / tensed up appearance in the abdominal region due to pain, arched back, squatting
- Urine – dysuria, polyuria, and perineal staining / irritation, haematuria (differentiate between plant porphyrins or uterine conditions)
- Polydipsia
- Dehydration
- Animal vocalising – piercing, harrowing squeak whilst urinating

NUTRITIONAL MANAGEMENT AND PREVENTION

Although nutrition is not the sole factor responsible for pre-disposing an animal to bladder stones, it certainly can be critical in alleviating the symptoms and preventing recurrence of the condition.

1. Assess rabbit’s diet:
   - Types and quantities of foods given
   - Total level of calcium
   - Forms of calcium and proportion of total
   - Calcium : phosphorus ratio

2. Consider the digestibility and availability of the calcium in the ingredients
   - Digestibility varies - calcium carbonate is ~81%, di-calcium phosphate ~55%, calcium oxalate, found in most leafy green foods is ~49% digestible.
   - Availability varies - oxalate (oxalic acid) and phytate (phytic acid), constituents within fibre can reduce the availability of calcium, as can certain types of fibre (e.g. bran).

3. Promote diuresis using fresh vegetables, but introduce gradually. Make certain all vegetables are fed wet to increase water intake.

4. Avoid vegetables such as kale, spinach, savoy cabbage, watercress and other dark leafy greens that are exceptionally high in calcium and can exacerbate the condition.

5. Reduce the quantity of dry diet being fed if there are any uncertainties over calcium levels, or introduce a specialist low calcium diet.
Alfalfa need not be excluded

- Alfalfa is very rich in calcium compared to other hays and vegetables.
- In coarse mixes, alfalfa can provide a fair proportion of the ration’s calcium content.
- Historically alfalfa was used as a herbal remedy by the Chinese, for relief from kidney disorders and bladder stones – it has natural diuretic properties.
- Much of calcium present as calcium oxalate crystals, and alfalfa has a high fibre content.
- Both fibre and oxalate can reduce the availability of calcium.
- Alfalfa fed alone or in high quantities may exacerbate urinary tract problems, but when fed as a proportion of the total diet in a mono-component feed (especially if it is low in calcium), it should not be cause for concern and can be a beneficial ingredient.
- Timothy hay is often recommended as the preferred hay to feed, as it is relatively low in calcium.

Rabbit Urinary Parameters

Typical Normal Parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Volume</td>
<td>20-350 ml / 24hr(^{2,3})</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.003 – 1.036(^{1}) (mean 1.015)</td>
</tr>
<tr>
<td>pH</td>
<td>7.6 – 8.8 (\pm 2.3 : 8.2-9.0)(^{1})</td>
</tr>
<tr>
<td>Creatinine</td>
<td>20-80 mg / kg / 24 hr(^{3})</td>
</tr>
<tr>
<td>Protein</td>
<td>0.7-1.9 mg / kg / 24 hr(^{2}) (negative to trace)(^{1})</td>
</tr>
<tr>
<td>Glucose</td>
<td>Negative to trace(^{1})</td>
</tr>
<tr>
<td>White Blood Cells</td>
<td>Rare(^{2})</td>
</tr>
<tr>
<td>Red Blood Cells</td>
<td>Rare(^{2})</td>
</tr>
<tr>
<td>Casts</td>
<td>None(^{2})</td>
</tr>
<tr>
<td>Crystals</td>
<td>Triple phosphate and calcium carbonate crystals are normal(^{1})</td>
</tr>
<tr>
<td>Bacteria</td>
<td>None to rare(^{1})</td>
</tr>
</tbody>
</table>


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