Diet, FLUTD, & Urinary Stones

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There is no evidence that diet directly causes **feline lower urinary tract disease** (FLUTD; formerly termed "FUS" or feline urologic syndrome). It does appear, however, that diet may increase the risk of a cat developing urinary crystals, stones, and urethral plugs. The development of crystals and stones is dependent upon the:

- Urine pH
- Urine volume
- Concentration of minerals in the urine

Whether a cat is allowed to eat throughout the day (free choice or *ad libitum* feeding) or has specific meal times can also influence lower urinary tract health. Genetics also appears to play a role.

Type of Stone	Percent of Stones in 1984	Percent of Stones in 1995
Struvite	75	48
Oxalate	2	40

In the past, crystals and stones which contained struvite (magnesium ammonium phosphate) were more common in cats. As a result, diets were developed to minimize the risk of forming struvite. These diets were low in magnesium and cats eating them produced an acidic (low pH) urine. As more cats were fed these diets, both for treatment and prevention of struvite, the percentage of cats with struvite stones decreased, but the incidence of calcium oxalate crystals and stones increased. Struvite is still the most common component of urethral plugs.

Reducing struvite in the urine

Struvite crystals are made up of magnesium, ammonium, and phosphate. The main dietary factors which appear to affect the development of struvite crystals are magnesium concentration, urine ph, and water consumption. Diets formulated to contain moderate to lower protein levels, lower magnesium levels, and, with increased urine acidifying potential, help minimize formation of struvite uroliths (stones).

Cats who are on diets designed to acidify the urine should NOT be given additional urinary acidifiers.

Urine pH: Although decreasing the amount of magnesium in the diet may have some effect on struvite formation, acidifying the urine has much more. The recommended urinary pH for cats is 6.0-6.5. The ***FDA*** will allow statements such as "reduces the urine pH to help maintain urinary tract health" on cat food labels. The claim can only be made if adequate, controlled studies were performed to demonstrate that consumption of the product results in an appropriately acidic urine. Since too much acidification of the urine can result in serious health problems, data to demonstrate safety of the product are reviewed as well. Feeding directions need to state that the product is recommended to be fed alone and should be made available throughout the day. Also, the nutritional adequacy statement on the label must be for adult maintenance only. Since the safety of these products for kittens and pregnant or nursing queens has not been established, the FDA recommends that these products not be used for these life stages.

Water intake and urine volume: An important influence on the development of urinary crystals and stones is the consumption of water; it is even more important than the magnesium level. As more water is consumed, the urine is less concentrated, and crystals are less likely to form. Also, since there is more urine, the cat will urinate more frequently, and the urine will be present in the bladder for a shorter period of time. This also decreases the chance of crystal and stone formation. Provide fresh, clean water at all times, and preferably in several areas around the house. For information on how to increase your cat's water intake see **Drinking Water: How can I encourage my cat to drink more?**.

Mineral concentration: The concentration of magnesium and phosphorus in the diet can

play a role in the development of struvite crystals and stones, especially if the urine is very ***alkaline***.

Ash and magnesium: Ash refers to the inorganic portion of a food sample that remains after the sample is burned at 600°C for two hours. Ash, then, includes calcium, phosphorus, sodium, potassium, magnesium, manganese, and the trace minerals found in the food. All of these minerals are required in the diet. Therefore, a certain amount of ash in food is necessary for a balanced diet.

According to the FDA, the claim, "low ash," is not allowed on cat food labels. The current scientific consensus is that ash per se is not related to the incidence of FLUTD. There are no valid reasons to reference ash on the product label (other than in the guaranteed analysis) except in regard to this outdated theory. Thus, "low ash" or similar claims, even without reference to FLUTD, are inherently false and misleading, which render the product misbranded and subject to regulatory action.

Lowering dietary magnesium has been thought to be important in lowering the risk of struvite formation in cats. Since magnesium is one of the constituents of ash, people assumed that a low ash content in food meant the food was low in magnesium. This, however, is not true. A low ash diet could contain normal amounts of magnesium, but be lower in one of the other minerals such as sodium or calcium.

With respect to dietary magnesium levels, the FDA's 'cut-off' criteria to support a "low magnesium" claim are:

- Less than 0.12% on a dry matter basis
- Less than 25 mg per 100 kilocalories of ***metabolizable energy***

To make a "low magnesium" claim, companies must submit the results of proximate analyses (including crude protein, crude fat, crude fiber, moisture, and ash) and magnesium analyses of a number of production runs of the product. Demonstration that the product formulation consistently meets the cut-off criteria supports the label claim. The estimation of magnesium content as calculated by using guaranteed analysis values on the product label must also meet the criteria.

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Not only the amount, but the form of magnesium in the food is important. The research on diet and struvite formation performed in the 1970's demonstrated that high levels of magnesium oxide in the diet could contribute to the formation of stones. This is not true if the magnesium is in the form of magnesium chloride. The difference appears to be that magnesium oxide causes alkaline urine, and magnesium chloride results in the formation of acidic urine.

It should be recognized that if a cat eats too much, he is also consuming more magnesium than is recommended. The excess mineral will need to be excreted in the urine, and may increase the risk of stone formation.

Phosphorus: Since phosphorus is a component of struvite, it would theoretically be of value to reduce dietary phosphorus in an attempt to reduce the formation of struvite stones and crystals. Slightly lower levels of dietary phosphorus may be beneficial, but extreme care needs to be taken to not reduce the phosphorus too much, since the ration of calcium to phosphorus is important to many body functions. In addition, acidified diets have been shown to decrease phosphorus levels in adult cats, which could further cause a calcium:phosphorus imbalance.

Feeding methods: It is recommended that cats who are at risk for developing struvite crystals or stones should be fed *ad libitum*. After eating a large meal, the pH of the urine usually becomes more alkaline. By eating small meals throughout the day, the urine pH will stay more acidic.

Reducing calcium oxalate in the urine

It appears that some cats are genetically predisposed to develop oxalate crystals if they are fed diets that result in acidic urine and are low in magnesium. To reduce the risk in these cats, diets formulated to contain moderate calcium, phosphorus, and magnesium levels, and with decreased urine acidifying potential should be fed.

Urine pH: Calcium oxalate crystals and stones are more likely to occur in acidic urine. Excess levels of vitamin C in the diet can acidify urine, and increase the risk of calcium oxalate crystals. Therefore, foods with high levels of vitamin C should be avoided.

Water intake and urine volume: Just as increased water intake will reduce the risk of struvite formation, it will also reduce the risk of oxalate crystals and stones. As more water is consumed, the urine is less concentrated, and crystals are less likely to form. Also, since there is more urine, the cat will urinate more frequently, and the urine will be present in the bladder for a shorter period of time. This also decreases the chance of crystal and stone formation. Provide fresh, clean water at all times, and preferably in several areas around the house.

Mineral concentration: To minimize the risk of the development of calcium oxalate stones, calcium, phosphorus, and magnesium should be at moderate levels in the diet.

Calcium and phosphorus: To minimize the risk of calcium oxalate development, dietary calcium and phosphorus should not be supplemented or restricted. High levels of urinary calcium increase the risk of calcium oxalate crystals, especially in concentrated acidic urine. High urinary calcium can result from excess intake of calcium in the diet, abnormal hormonal regulation of calcium levels by the parathyroid gland (primary **hyperparathyroidism**), and excess vitamin D intake.

It is important that the calcium intake not be severely restricted, either. Decreasing calcium in the diet to an abnormally low level may actually increase the amount of calcium oxalate found in the urine. When calcium is high in the diet, it decreases the absorption of oxalate from the digestive system, and the excess oxalate is excreted in the feces. When dietary calcium is low, more of the oxalate is absorbed from the digestive system and is then excreted in the urine.

Levels of phosphorus in the bloodstream affect the levels of calcium. Therefore, phosphorus should not be fed in excess or restricted. Vitamin D should also be fed at a moderate level, since deficiencies or excesses of this vitamin can result in abnormal blood and urine calcium and phosphorus levels.

Magnesium: Diets that are either very high in magnesium, or very low in magnesium, can increase the risk of calcium oxalate stones. Research results have suggested that to decrease the risk of calcium oxalate uroliths, dietary magnesium should not be restricted or supplemented.

Summary

Diet can influence the health of the urinary tract. By controlling mineral levels, changing the urine pH, increasing water intake, and adjusting feeding schedules, the risk of a cat developing urinary crystals and stones can be decreased.

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