

Leslie Bean with Fuzzerbear



Treatment and prevention of calcium oxalate kidney and bladder stones

Adapted from an article by CJ Puotinen and Mary Straus, published in the [Whole Dog Journal](#), May 2010

Bladder and kidney stones are serious problems in dogs as well as people. These conditions – which are also known as uroliths or urinary calculi – can be excruciatingly painful as well as potentially fatal. Fortunately, informed caregivers can do much to prevent the formation of stones and in some cases actually help treat stones that develop.

In this article, we examine calcium oxalate or CaOx stones.

CaOx stones occur in both the bladder (lower urinary tract) and kidneys (upper urinary tract) of male and female dogs. Most calcium oxalate uroliths are nephroliths (found in the kidney), and most of the affected patients are small-breed males. CaOx uroliths are radiopaque, meaning that they are easily seen on radiographs (X-rays).

Twenty-five years ago, struvites were the most common uroliths collected from canine patients, representing almost 80 percent of the total, while only 5 percent were calcium oxalate stones. The percentage of struvite uroliths found has declined while that of CaOx stones has risen, so that nearly half of all canine uroliths analyzed today are calcium oxalate stones. It's unknown whether the incidence of struvite stones has decreased or if the change is due solely to an increase in calcium oxalate uroliths.

Similar changes have occurred in cats, but in that case, we have a good idea why. Twenty years ago, calcium oxalate stones were virtually unheard of in cats, who commonly formed sterile struvites. In an effort to reduce the risk of struvites, pet food manufacturers began adding urinary acidifiers while reducing the magnesium content of foods. This resulted in a reduced incidence of struvite stones, but calcium oxalate stones developed instead.

In addition to breed and sex, risk factors for CaOx stones include being overweight, under-exercised, neutered, and eating a dry food diet, which contributes to more concentrated urine. Small dogs are thought to be more susceptible because they drink less water relative to their size than large dogs do.

One risk factor is insufficient or abnormal nephrocalcin, a strongly acidic glycoprotein present in normal urine that inhibits calcium oxalate crystal growth. Dogs who produce normal and sufficient nephrocalcin have a reduced risk of developing calcium oxalate stones.

Certain prescription drugs contribute to the formation of CaOx uroliths. Prednisone and other cortisone-type medications prescribed for inflammatory illnesses such as arthritis, itchy skin, or inflammatory bowel disease, can contribute to the formation of CaOx stones. So can the diuretic drug furosemide (brand names Lasix or Salix), which is given to dogs with congestive heart failure. Thiazide-class diuretics are recommended in place of furosemide for dogs who are prone to forming CaOx stones.

Some nutritional supplements, such as vitamins C and D, are believed to contribute to the formation of oxalate stones.

Uroliths can develop in any breed, but the greatest number of calcium oxalate stones presented for analysis have come from Miniature Schnauzers, Bichon Frises, Standard Schnauzers, Lhasa Apsos, Shih Tzus, Yorkshire Terriers, Miniature Poodles, Pomeranians, Parson Russell Terriers, Papillons, Keeshonds, Samoyeds, Chihuahuas, Cairn Terriers, Maltese, Toy Poodles, West Highland White Terriers, Dachshunds, and mixed breeds.

Cocker Spaniels, German Shepherds, Golden Retrievers, and Labrador Retrievers are believed to be at *decreased* risk of CaOx stones.

In a study published in the *American Journal of Veterinary Research* in 2001, eight healthy Labrador Retrievers and eight healthy Miniature Schnauzers, all about three years old, were fed the same nutritionally complete dry dog food for 24 days while being monitored for calcium oxalate risk factors. The Miniature Schnauzers urinated significantly less often and had a higher urinary calcium concentration. These observations led researchers to conclude that important differences in urine composition exist between breeds fed the same diet.

Conventional veterinary practitioners tend to consider calcium oxalate stones irreversible, unaffected by diet or medical therapy, and untreatable except by surgery. They may attempt to remove small bladder stones by flushing the bladder with sterile saline, or perform shock wave or laser lithotripsy (processes that break stones into small pieces that can be flushed out or excreted in the dog's urine). Surgery may not be necessary for stones that are clinically inactive (not growing or causing problems).

Uroliths pose a more serious problem for male dogs than females, because their urine travels through a hollow bone (os penis) that surrounds the urethra within the penis. The bone cannot stretch or expand to accommodate a stone traveling through it, and obstructions readily result.

For males with recurring stones, a surgical procedure called urethrostomy sends urine on a new path, avoiding the os penis. The urethrostomy creates a new urinary opening in the scrotum area. This type of surgery cannot be performed unless the dog is neutered; if he is intact, he can be neutered at the time of the urethrostomy.

In up to 60 percent of conventionally treated patients, calcium oxalate stones recur within three years. In dogs with Cushing's Disease (hyperadrenocorticism) or excessive calcium in the blood (hypercalcemia), both of which predispose dogs to CaOx stones, the recurrence rate is faster. It's important to treat these underlying causes, if found, to help prevent recurrence.

The recurrence rate among Bichons is higher than that of any other breed. In a study presented at the 2004 meeting of the American College of Veterinary Internal Medicine, 24 out of 33 Bichons had oxalate stone recurrence after cystotomy. During the first year after surgery, 37 percent of these patients had their first recurrence; by the end of the second year, 57 percent did; and by the end of the third year, 73 percent had at least one recurrence and some had more than one.

Calcium oxalate crystals are of concern, but their presence doesn't necessarily mean your dog is at risk of forming stones. Crystals are significant only if found in fresh urine. Crystals that form when urine is refrigerated or analyzed more than 30 minutes after collection may be incidental and not indicative of a problem. Dogs with calcium oxalate crystals in fresh urine should be monitored, and if the finding continues, steps should be taken to reduce the risk of stone formation, particularly in breeds most commonly affected.

From death sentence to discovery

In 1997, Molly McMouse, a 14-year-old Lhasa Apso belonging to Leslie Bean of Houston, Texas, was diagnosed with very dense, inoperable calcium oxalate stones affecting both kidneys. Bean owned three more Lhasas – 15-year-old FuzzerBear, 13-year-old Peepers, and 11-year-old CB Wigglesworth – who were closely related to Molly. Fearful that

her other dogs could be afflicted by the same condition, Bean had them tested, too, and was shattered when each received the same diagnosis.

“My husband and I were told that oxalates only proliferate in size and number,” she recalls, “and that as the calcification of their kidneys increased, all four of our dogs would die, probably within six to nine months.”

At the time, Bean was founding director of patient advocacy at the University of Texas MD Anderson Cancer Center, a position that helped her contact medical experts of every description. She checked with veterinarians, veterinary researchers, and directors of veterinary schools and laboratories around the country, only to receive the same sad news from all.

“Every one of them said these stones cannot be dissolved,” she says. “They all felt bad about it, but they agreed that the prognosis for my dogs was hopeless.”

Bean’s Lhasas had been on a premium, holistic food, but after their diagnoses, at the recommendation of their veterinarians, Bean put them on a low-protein, low-phosphorus, low-sodium prescription diet. The dogs disliked the new food and their to-the-floor show coats rapidly dulled.

At that point, Bean says, “I accepted the fact that my dogs were going to die but I wanted to make their final months as terrific as possible.” Tossing the prescription food, she began feeding fresh foods such as lamb and peas, chicken and rice, and beef and broccoli. “I figured if they had so little time, they were damned well going to enjoy what they ate,” she says, “and they *loved* it. I can still see them singing and dancing with joy when I carried their bowls to their places. Literally within two weeks they began acting more energetic, looked younger, had a spring in their step, and their eyes were clearer. Their coats looked better, too, and we soon had to cut almost an inch in length from each dog every month. Although that is common in young Lhasas in show coat, the rate of growth slows with age, so this was a really noticeable difference.”

Because oxalic acid forms strong mineral bonds that can become calcium oxalate crystals and eventually CaOx stones, Bean speculated that low-oxalate foods might help prevent the stones’ formation (see Oxalates in Food below), and she made those ingredients the foundation of her dogs’ menus.

Protein

In the past, diets restricted in both protein and phosphorus were thought to reduce the risk of calcium oxalate formation. Studies found, however, that dietary phosphorus restriction increased calcium absorption and the risk of calcium oxalate formation, while higher levels of dietary protein reduced the risk of urolithiasis. **Current recommendations for dogs prone to forming CaOx stones say that diets should *not* be restricted in protein, calcium, or phosphorus.**

In February 2002, *The American Journal of Veterinary Research* published a study conducted at the University of Minnesota College of Veterinary Medicine’s Minnesota Urolith Center that compared dietary factors in canned food with the formation of calcium oxalate uroliths in dogs, with surprising results. Canned diets with the highest amount of carbohydrate were associated with an *increased* risk of CaOx urolith formation. Contrary to commonly accepted beliefs, the study concluded that “canned diets formulated to contain high amounts of protein, fat, calcium, phosphorus, magnesium, sodium, potassium, chloride, and moisture and a low amount of carbohydrate may minimize the risk of CaOx urolith formation in dogs.”

In contrast, both Hill’s Canine u/d and Royal Canin Urinary SO, often prescribed for dogs prone to forming CaOx stones, are extremely low in protein, and restrict calcium, phosphorus, magnesium, and potassium (Royal Canin is less restrictive than u/d). See *The Side Effects of Low Protein Diets* for more information.

At the beginning of her nutritional experiment, Bean reduced her dogs' protein levels so much that they began to lose muscle mass.

"After much research, analysis, and discussion with my veterinarians," she says, "I increased their protein levels to 33-40 percent of the total volume of food. They quickly regained their lost weight and muscle, and there were no further problems with muscle loss."

As Bean discovered, it's very important not to reduce protein too much. Even the most severely phosphorus-restricted diets for renal failure recommend feeding a minimum of 1 gram of protein per pound of body weight daily (as determined by a nutritional analysis, not grams of meat).

Recheck

As the Lhasas continued to thrive, their primary veterinarian, Jane Milan, encouraged Bean to return them for another ultrasound test to the veterinarian, a specialist in internal medicine, who had first diagnosed them. "I just didn't want to hear bad news," says Bean, "so I kept putting it off."

Eight months after their diet change and past or near their predicted death dates, she made the appointment. "I was really nervous," she says. "They looked terrific, but I had no way of knowing what was going on inside them. And the vet was with them for an unusually long time, which made me even more anxious."

Finally the somber-looking veterinarian returned to the waiting room carrying two of the dogs and said, "I don't know how to tell you this."

Bean assumed that her other two dogs had died during their ultrasound tests and she nearly fainted, but the vet's good news revived her. The calcium oxalate stones that had been ticking time bombs were nowhere to be found. That's what caused the long delay – he could not at first believe his test results. "The two older dogs still had five tiny stones," she says, "but they had shrunk to the size of pin-dots, and they soon disappeared."

Despite the kidney damage already caused by their calcium oxalates, each of the already senior Lhasas lived several more years. FuzzerBear died at age 19, the other three lived to be 18, and frequent check-ups showed all four to be completely free from calcium oxalate stones for the rest of their lives.

At the suggestion of their veterinarians, Bean continued to study canine nutrition and assembled a set of guidelines that described her dogs' regimen.

"I am not a veterinarian licensed to practice veterinary medicine in any state and make no claims or representations as such," Bean reminds everyone. "I am simply a pet owner whose dogs suffered from intractable problems. I developed FuzzerFood, named for Fuzzerbear, based upon the independent research I conducted to help my own dogs. My discoveries are not intended to be veterinary advice, nor are they a drug, biologic, or other therapeutic or diagnostic substance or technique designed to replace a consultation with a qualified veterinarian."

She recommends that owners of dogs with calcium oxalate stones work closely with their veterinarians, beginning with a baseline ultrasound, complete blood panel, and urinalysis. "Start now if you have not already," she suggests, "to maintain records of blood work and urinalysis reports as well as your own notes as you go."

Water, the key ingredient

The most important thing you can do for a stone-prone dog is increase fluid consumption and opportunities to urinate. Urine becomes concentrated when insufficient fluids are consumed or when dogs are not able to relieve

themselves and have to hold their urine for long periods. And concentrated urine contributes to supersaturation with minerals that can precipitate into crystals and lead to stones.

Special diets limit certain minerals and manipulate the ingredients to create a urine pH (measurement of acidity or alkalinity) that is unfavorable for crystals and stones to form. Those of you with pets that have had multiple surgeries to remove bladder stones are well aware of the limitations of these diets to successfully prevent stone formation. The answer appears to be water, H₂O, and more water.

One way to encourage dogs to increase their water consumption is to add salt to their food, but salt is controversial when it comes to calcium oxalate uroliths. Increasing dietary salt encourages the kidneys to excrete more calcium, raising urinary calcium levels.

One might predict that increased sodium would therefore lead to increased calcium oxalate formation, but that isn't necessarily true. In a 2003 study, dogs were fed dry diets containing varying amounts of sodium. The diets that contained 300 mg sodium (about 1/8 teaspoon salt) per 100 calories significantly reduced urinary calcium oxalate supersaturation over diets containing 60 mg or even 200 mg sodium per 100 calories. Increased fluid consumption resulting from the thirst generated by additional salt probably offset the increase in calcium excretion. A human retrospective study published in 2009 concluded, "Increasing urine sodium does not appear to increase the risk of calcium oxalate nephrolithiasis (kidney stones)."

Bean, however, does not add salt to food. The majority of human studies indicate that adding salt is inadvisable, and many who elected to apply the FuzzerFood regimen for their own dogs were unsuccessful in attempts to dissolve or prevent recurrence of calcium oxalate stones when they departed from the guidelines Bean developed for her own dogs.

You can help your dog drink more by providing fresh water in clean dishes in several locations; changing the water frequently; adding small amounts of tuna water, salt-free or low-sodium broth, a favorite juice, or other flavoring agent to drinking water in addition to offering plain water; adding water to food; offering ice cubes as treats; using a pet water fountain to provide continuously filtered fresh running water; offering water at every opportunity; and carrying water and a portable bowl while hiking or traveling.

What type of water should you use? Bean prefers steam-distilled water because it contains no minerals that might combine with excess oxalic acid. Physicians she consulted with told her that both hard and soft water may increase the risk of calcium oxalate formation. Reverse-osmosis water filters remove 95 percent of minerals, making RO-filtered water nutritionally similar to distilled water.

Not all minerals in water contribute to kidney or bladder stones. In several studies conducted in the 1990s, human patients who formed calcium oxalate nephroliths drank a French mineral water containing high levels of calcium (202 parts per million) and magnesium (36 ppm). Nearly every risk factor for calcium oxalate nephroliths improved significantly. The same patients also drank local tap water and mineral water with low calcium/magnesium concentrations, neither of which improved the measured risk factors. The researchers concluded, "The risk of calcium oxalate stone formation can be significantly reduced by consumption of mineral water which is rich in calcium and magnesium."

Other research on the effects of hard and soft water on urolith formation has shown mixed results regarding risk, possibly due to variations in mineral content and ratios, along with factors such as whether the water was given with or between meals. For this reason, distilled water may be safest, particularly for dogs with kidney stones or recurrent bladder stones.

Getting extra water into your dog is only part of the urolith-prevention strategy. Just as important is the frequent release of urine. Give your dog many opportunities to go outside during the day. If your dog is indoors alone or

crated for hours each day, find a way to create a convenient elimination area using plastic, newspapers, towels, a patch of sod, or whatever you can devise to keep your dog from having to hold her urine for long periods.

Urinary pH

Calcium oxalate stones form in urine that is acidic, typically measuring between 5.0 and 6.5 on the pH scale. Calcium oxalate crystals are generally not sensitive to urinary pH, but marked acidification that induces metabolic acidosis can promote calcium oxalate stone formation due to increased urinary calcium concentration.

A common recommendation for dogs prone to forming calcium oxalate stones is to alkalize the body with foods or medications to bring the urinary pH closer to 7, which is neutral. Alkalizing the urine will not cause existing stones to dissolve but may help prevent new stones from forming. It's important not to try to alkalize the urine too much, as this can lead to the formation of calcium phosphate stones.

You can monitor your dog's urine by holding a pH test strip (see Resources) in the stream or by collecting urine in a paper cup or clean dish for testing.

But don't be surprised if your dog's urinary pH stays where it is. Leslie Bean describes her careful monitoring of her dogs' urinary pH as a source of discouragement. "I thought that unless I could bring their pH higher, their stones would increase," she says. "To the contrary, not only did they not increase, the stones dissolved. I learned that the key is to monitor the pH and know where you are, but not to panic if the urine stubbornly remains more acidic than you would like."

Oxalates in food

Oxalic acid is found in both plants and animals, with plants containing higher levels. It forms strong bonds with sodium, potassium, magnesium, and calcium, creating oxalate salts. The term "oxalate" usually refers to a salt of oxalic acid, one of which is calcium oxalate. Sodium and potassium oxalate salts are water-soluble, but calcium oxalate is not, and it is what forms CaOx uroliths.

In recent years interest in low-oxalate diets has increased because of possible links between oxalates and human kidney stones, arthritis, fibromyalgia, female vulvar pain, autism and other pervasive developmental disorders, and chronic inflammation. As a result, there is growing demand for accurate data on the oxalate content of foods.

When Bean began her research 13 years ago, much of the information published about this subject was quite old. Eventually she found a small booklet published by the University of California at San Diego, "Oxalate Content of Select Foods," which featured more current data and gave her a list of foods to include and avoid.

Today, the Oxalosis and Hyperoxaluria Foundation (see Resources) publishes an up-to-date list of foods and their oxalate content. Based on research from 2008 and revised as new figures become available, this report divides foods into very high, high, medium, and low levels of oxalates according to serving size (see Oxalate Content of Various Foods below).

The foods in Group 1 (very high-oxalate foods) are best avoided by dogs prone to calcium oxalate stones. Group 2 (high-oxalate) foods should also be avoided:

Group 3 foods have moderate oxalate levels. They can be fed in moderate amounts as long as calcium is also given with the meal. Group 4 (low-oxalate foods) are "green light" ingredients, and can be fed in any quantity, though they should still be combined with calcium. See the complete list, available through the Oxalosis and Hyperoxaluria

Foundation (see Resources) for information about additional foods, including herbs, spices, combination foods, and beverages.

Some websites and publications incorrectly list meat, liver, other organ meats, shellfish, cheese, yogurt, broccoli, sardines, cherries, Brussels sprouts, olives, and strawberries as dangerous for CaOx-sensitive dogs, based on outdated information. All of those foods are actually low in oxalates.

Designing the menu

Because it's difficult to find commercial foods made without ingredients that are problematic for dogs prone to CaOx stones, home-prepared diets may produce the best results. For those who already feed a home-prepared diet to their dogs, the adjustments are simple. For those who are new to dog food preparation, designing an effective menu need not be complicated. Your dog's food can be prepared along with your own meals or made in advance and refrigerated or frozen in single portions for later use.

Start by feeding different types of meat, poultry, eggs, fish, and dairy in order to provide a variety of flavors and nutrients. The food Bean feeds her dogs is about 40 percent protein by volume, but higher protein levels work well for many dogs. The rest of the diet should be low-oxalate grains and/or vegetables.

While Bean doesn't include organ meats in her FuzzerFood guidelines, adding 1/2 ounce (about 1 tablespoon) of liver per pound of other foods will add valuable nutrients to a home-prepared diet.

Meat can be ground, cut into cubes, or served in a single piece, assuming the dog doesn't have problems chewing. It can be fed raw or cooked. Because CaOx dogs on raw bone-based diets have continued to form stones, the FuzzerFood regimen does not include bones. Freeze-dried liver and similar dog treats are appropriate for training and special occasions. Avoid treats that contain high-oxalate ingredients, and factor treats into the daily food allotment of overweight dogs.

Boiling vegetables in water greatly reduces their oxalate content, while steaming reduces levels slightly. Of course, boiling reduces nutritional content, so it's a trade-off. When you feed Group 3 (moderate-oxalate) vegetables, consider giving smaller amounts raw and larger amounts cooked. Adding digestive enzymes to food at serving time helps replace enzymes destroyed by heat.

Most 10-pound dogs need less than 1 cup of food by volume, while dogs weighing 50 pounds may need closer to 3 cups per day. Bean's Lhasas maintain their 12- to 14-pound body weight on slightly more than 1 cup per day. The amount to feed will vary according to your dog's activity level and the amount of low-calorie vegetables in the diet.

Because key supplements should be given twice a day with food, consider feeding both breakfast and dinner rather than one meal per day.

Calcium

In the past, calcium was thought to be a risk factor for the formation of calcium oxalate stones. Later studies found, however, that calcium binds oxalate and thus actually reduces the risk of calcium oxalate stones when given with meals.

When she spoke with urologists who deal with human kidney stones, Bean learned that supplementing homemade food with calcium citrate neutralizes oxalates in urine, so she began giving it to her dogs with meals while avoiding all other mineral supplements. "Citrate is an important natural inhibitor of calcium oxalate stones," she says. "When calcium citrate is combined with food at mealtime, it helps absorb and bind excess oxalic acid in the gut. This bound

oxalate cannot be absorbed and is excreted through the feces. This means that it does not get into the bloodstream or kidneys to cause stones.”

Pure calcium citrate powder is inexpensive and easy to use. Bean adds 300 to 350 mg of NOW brand Vegetarian Powdered Calcium Citrate to each 8 ounces (1/2 pound) of fresh food to balance the diet’s calcium:phosphorus ratio. Calcium citrate should only be added to homemade diets, or to the fresh portion of a combined diet, as commercial diets should already contain the right amount of calcium (though, unfortunately, they rarely use calcium citrate).

Supplements

For more than 40 years, the medical literature has reported on the success of a simple nutritional therapy for the prevention of calcium oxalate stones in humans using magnesium and vitamin B6. In studies published in *The American Journal of Clinical Nutrition*, *The Journal of the American College of Nutrition*, and other medical journals since 1967, patients with longstanding, recurrent calcium oxalate kidney stones received 200, 300, or 500 mg magnesium oxide with or without 10 mg pyridoxine (vitamin B6) daily for five years or more, during which their stone formation fell by over 90 percent. When measured, their urine increased its ability to keep calcium oxalate in solution.

Because vitamin B6 deficiencies can contribute to an increase in oxalate production, many veterinarians prescribe this vitamin for dogs prone to CaOx stones. Severe vitamin B6 deficiencies may result from genetic disorders. Vitamin B6 is available as an oral supplement or by injection. Follow label directions or, if using a human product, give 1/4 of the total dose for each 25 pounds of body weight.

A B-complex supplement provides all of the needed B-family vitamins. Give 50 mg twice per day to dogs weighing 50 pounds or more, and one-fourth or half that amount to smaller dogs.

The FuzzerFood regimen includes Omega-3 fish or salmon oil, a B-complex vitamin, and vitamin E, with optional CoQ10, magnesium, glucosamine, digestive enzymes, and probiotics.

One study done on people showed that the urinary oxalate was greatly reduced using a high concentration of freeze-dried lactic acid bacteria (*Lactobacillus acidophilus*, *L. plantarum*, *L. brevis*, *Streptococcus thermophilus*, *Bifidus infantis*, with the last possibly being the most effective). **Nature's Sunshine Probiotic Eleven** (available at Amazon) and **Sedona Labs Iflora** (available at Amazon) contain all five of the named strains, while VSL#3 contains four of the five (also available at Amazon).

Updated information on probiotics: See Probiotic-induced reduction of gastrointestinal oxalate absorption in healthy subjects and Acute probiotic ingestion reduces gastrointestinal oxalate absorption in healthy subjects for human studies of VSL#3. Other studies indicate that *Oxalobacter formigenes* is the best known of the oxalate-degrading bacteria, including in dogs, but this species does not appear to be available in supplement form. In a study completed in 2012, Dr. Michael Murtaugh, from the University of Minnesota, determined that healthy dogs have higher quantities of three bacteria that degrade oxalate than do dogs prone to forming oxalate stones. The probiotic species are not named, but presumably include *O. formigenes*. Dr. Murtaugh now hopes to develop a probiotic containing bacteria that is capable of degrading oxalate and preventing formation of oxalate urinary stones.

Magnesium can have a laxative effect, so begin at the low end of the range, which is 3 to 5 mg per pound of body weight per day, divided into morning and evening doses and given with meals. Magnesium supplementation is contraindicated for dogs in renal failure, so if that is your dog’s condition, use this under your veterinarian’s supervision only as long as there are stones, then discontinue.

Bean does not use either vitamin C or vitamin D (including cod liver oil, which contains vitamin D) because vitamin C is said to convert to oxalate, thus possibly increasing the risk of stone formation, and vitamin D promotes calcium absorption that leads to increased urinary calcium. Most multi-vitamins contain vitamins C and D, so it's important to read labels.

Supplements manufactured for human consumption come in a wider variety than do veterinary supplements, making it easier to find human products that avoid these ingredients. Adjust the recommended human dose for your dog by weight.

Some researchers have found that glucosamine supplements, which are commonly used for arthritis, may help prevent calcium oxalate crystals from adhering to the bladder wall. While this treatment is still speculative, glucosamine is safe to give and may be helpful in preventing CaOx bladder stone formation.

When Bean asked Traditional Chinese Medicine veterinarian Cory Stiles, DVM, for advice from that perspective, Dr. Stiles recommended Lysimachia-3, a traditional Chinese blend of three herbs, *Jin Qian Cao* or Desmodium, *Hai Jin Sha* or Lygodium Spores, and *Ji Nei Jin* or Gallus, which is designed to treat human digestive disorders, gall stones, and kidney stones.

"Lysimachia-3 comes in tablets," says Bean, "which we crushed and mixed with food, or the tablet can be placed in a small amount of low-fat cream cheese, or the dog can simply be 'pilled' by putting it down the throat. My dogs had no objection to having these tablets crushed and mixed with their food, and Lhasas are notoriously picky." Dr. Stiles' recommended dose is 1 700-mg tablet per 25 pounds body weight given twice daily until stones are dissolved. Then give Lysimachia-3 daily for another month, then start using it every other day, then every three days, and if all looks good, dose it three times per week every other week, and finally, daily for one week out of every four to six weeks.

Preventive medical treatment

Potassium citrate is a nutritional supplement that increases citrate levels in the urine, attracting calcium away from oxalates. When calcium binds to citrate, the resulting calcium citrate tends to remain dissolved instead of precipitating out as a mineral deposit.

Potassium citrate also has an alkalizing effect on the urine, which can help to prevent the formation of calcium oxalate stones, though it won't dissolve existing stones. High blood potassium levels are dangerous, so a veterinarian's supervision and follow-up blood tests are recommended when using potassium citrate. This supplement should usually not be given when dietary changes alone maintain the urine's pH at 6.5 or above.

Calcium citrate achieves the same goals of alkalizing urine and binding oxalates without the risk of elevated potassium that can be posed by potassium citrate. That's why Bean considers calcium citrate a better option for her dogs' homemade diets.

Dogs who continue to form stones despite other steps to minimize risk may be prescribed hydrochlorothiazide, a thiazide diuretic, to increase the amount of urine produced while reducing urinary calcium oxalate saturation.

The stress connection

In addition to good food and ample water, dogs need a stable home life, active exercise, and interesting activities. Some researchers speculate that stress plays a role in the development of kidney and bladder stones. When changing your dog's diet, do what you can to keep the introduction of new foods fun and stress-free. Fortunately, most dogs love fresh food. Just as importantly, do what you can to relax and let go of the stress that concern about your dog's

health brings to your own life. The more you and your best friend enjoy each other's company with play, exercise, and shared quiet moments, the better you'll both feel.

Prescription Diets

For those who cannot feed a homemade diet, you could try feeding a prescription diet (Royal Canin S/O or Hill's Prescription Diet C/D Multicare), but add meat, eggs and dairy to increase the protein level and the quality of the overall diet. Add calcium citrate at the rate of 1,000 mg per pound of added fresh food. Also add a B-complex vitamin, probiotics and magnesium.

Alternatively, you could try feeding a commercial diet that doesn't have any high-oxalate ingredients, along with the same supplements listed above. Canned foods usually are higher in protein and lower in carbohydrates (which is where you find most oxalates), but may be prohibitively expensive for large dogs. Frozen and refrigerated raw and cooked diets may also be an option, but are even more expensive than canned foods.

All commercial foods add vitamin D and none use calcium citrate exclusively to provide calcium, so it's possible these diets could cause problems even if you avoid high-oxalate ingredients.

In any case, you should do everything possible to encourage your dog to drink more water and urinate frequently. Pulsing Lysimachia-3 may also help to prevent stone formation (see Supplements above). Monitor your dog's urine frequently for calcium oxalate crystals and/or do x-rays to check for stones beginning to form.

Oxalate Content of Various Foods

The Oxalosis and Hyperoxaluria Foundation publishes an up-to-date list of foods and their oxalate content. Based on research from 2008 and revised as new figures become available, this report divides foods into very high, high, medium, and low levels of oxalates according to serving size. See the complete list for information about additional foods, including herbs, spices, combination foods, and beverages at <http://www.ohf.org>.

Note that different sources provide differing information on oxalates. If you will be feeding a food regularly, you may want to check all the lists under Resources below for that food to further verify the oxalate content.

Soaking grains overnight and discarding the water, then boiling the grains (like pasta) and again discarding the water, can reduce oxalate content.

Group 1 (very high-oxalate foods) are best avoided by dogs prone to calcium oxalate stones:

- Bran cereal, almonds, buckwheat flour, beets, miso (fermented soy), mixed nuts, sesame seeds, tahini (sesame paste), parsley, rhubarb, spinach, and Swiss chard. Alfalfa and quinoa are also high in oxalates (not sure which group they belong in).

Group 2 (high-oxalate) foods should also be avoided:

- Nuts: cashews, hazelnuts or filberts, peanuts, peanut butter, and pecans.
- Vegetables: okra, collard greens, mustard greens, fried potatoes, sweet potatoes, and canned tomato paste.
- Legumes: black, white, great northern, navy, chili, and pink beans.
- Soy products: textured vegetable protein, soy milk, soy burger, soy yogurt, soy nuts, and soybeans.
- Fruit: figs, kiwi fruit, and dried apricots.

- Grains: barley, cornmeal, cream of wheat, whole wheat flour and spaghetti, brown rice flour, and wheat bran.
- Chocolate, which is toxic to dogs, is a high-oxalate food.

Group 3 foods have moderate oxalate levels. They can be fed in moderate amounts (see the complete list at <http://www.ohf.org> for serving sizes) as long as calcium is also given with the meal:

- Nuts and seeds: pistachios and walnuts (macadamia nuts are toxic to dogs).
- Vegetables: carrots, celery, green beans, boiled white potatoes without the skin, rutabaga, summer and winter squash, tomato sauce, and tomatoes. *The Low Oxalate Cookbook* (see Resources) shows that skinless red potatoes are considerably lower in oxalates than white or russet potatoes; all potatoes are lower in oxalates when the skin is removed.
- Legumes: kidney, pinto, and adzuki beans.
- Fruit: blackberries, blueberries, mandarin and other small oranges, mangos, and prunes. Note berries may be higher in oxalates, while mangos may be low.
- Grains: bulgar wheat, brown rice, elbow macaroni, egg noodles, spaghetti, pasta, rye flour, oats, and oatmeal.

Group 4 (low-oxalate foods) are “green light” ingredients. They can be fed in any quantity, though they should still be combined with calcium. Foods in boldface are particularly low in oxalates:

- Nuts and seeds: **coconut, flax seeds**, pumpkin and squash seeds, and sunflower seeds.
- Vegetables: artichokes, **asparagus, avocado**, broccoli, **Brussels sprouts, cabbage, cauliflower, corn, cucumber, garlic**, green or red peppers, **lettuce, mushrooms, peas, canned pumpkin, sauerkraut**, canned string beans, tomato juice, **canned water chestnuts, and zucchini**. (Onions should never be fed to dogs).
- Legumes: lima beans, **black-eyed peas**, garbanzo beans, lentils, and split peas. Lentils and garbanzo beans may have more oxalates. Split peas have more oxalates than regular peas.
- Fruit: apples, fresh apricots, bananas, **cantaloupe, cherries, cranberries**, grapefruit, **lemons**, lychee, **melons of all types, nectarines, olives**, oranges, **papayas, passion fruit, peaches**, pears, **pineapple, plums**, raspberries, strawberries, tangerines, and **watermelon**. (Neither grapes nor raisins should ever be fed to dogs).
- Grains: **white bread**, whole wheat bread, cornbread, **hominy (corn grits)**, oat bran, rice noodles, semolina, white rice, corn and white flour tortillas, and **wild rice**.
- Fats: all fats and oils, including butter.
- Fish: all fish and seafood (shellfish).
- Dairy: **all**, including **cheese, cottage cheese, cream, eggs, yogurt, ice cream**, and **sour cream**.
- Meat: **all meat** and **poultry**, including organ meats, **luncheon meats, sausage**, and **bacon**.
- Sweeteners: all natural sweeteners, including sugar (not recommended for dogs) and honey.

A Stone Glossary

Calculi (the plural of calculus) - urinary stones.

Hematuria - blood in the urine, a symptom of urinary stone disease.

Hypercalcemia - excessive calcium in the blood.

Hypercalciuria - excessive urinary calcium excretion.

Hyperoxaluria - excessive oxalate in the urine.

Nephrocalcin - a strongly acidic glycoprotein present in normal urine, which inhibits calcium oxalate crystal growth.

Nephroliths - kidney stones.

Oxalosis - excessive accumulation of oxalate in the body because of kidney failure.

Urinary tract stone disease - also called urolithiasis, urinary stones, ureteral stones, bladder stones, urinary calculi, ureteral calculi, or urinary calculus disease.

Uroliths - aggregates of crystalline and occasionally noncrystalline solid substances that form in one or more locations within the urinary tract.

Signs of stones

Watch for blood in your dog's urine, the frequent passing of small amounts of urine, "accidents" in house-trained dogs, straining to urinate while holding the position much longer than usual, licking the genital area more than usual, painful urination that causes your dog to yelp from discomfort, cloudy and foul-smelling urine that may contain blood or pus, tenderness in the bladder area, pain in the lower back, or fever and lethargy.

If you notice any of these symptoms, contact your veterinarian at once. A dog who strains and then releases a flood of urine may have just passed a stone and should be examined. If you can find the stone, take it with you so it can be accurately identified. A dog whose urine is completely blocked has a medical emergency; a plugged urethra can cause urine to back up into the system, resulting in kidney failure. The backup can also cause the dog's bladder to stretch to the point of rupturing or damaging the bladder's muscle tone, making it to empty completely.

Another Success Story

In September 2008, Cosette, a Shih Tzu belonging to Atlanta-area dog trainer Cathy Bruce, was diagnosed with 20 calcium oxalate bladder stones. In an effort to avoid surgery, Bruce experimented with her dog's diet. She was able to raise Cosette's urinary pH slightly, but it never got above 7.0. Cosette disliked the new foods and lost a pound while follow-up X-rays (taken three and six months after diagnosis) showed no change.

In the summer of 2009, when Bruce began feeding a commercially prepared frozen raw diet. Cosette's appetite returned and she regained the weight she had lost. At about the same time, with her veterinarian's approval, Bruce began adding small amounts of potassium citrate to Cosette's food. She had tried potassium citrate granules months before but Cosette wouldn't eat any food they were mixed with. When the powder from Nature's Farmacy potassium citrate capsules was added to her food, Cosette never noticed.

Soon the stones began to disappear, either because she passed them or they dissolved, and by March 2010, only four tiny uroliths remained. Cosette won't be needing surgery!

Sample Recipe

Here is a sample recipe that could be used for dogs prone to forming calcium oxalate stones. This recipe has a moderate amount of fat. Meat and eggs can be fed raw or cooked (the amount of meat is the same, but the starting weight is higher for raw foods due to having more moisture). Rice must be cooked. Vegetables should be either cooked or pureed in a food processor, blender, or juicer. Measurements are by weight, not volume (except for the cooked rice, which is given in cups). Use a small kitchen or postal scale for accuracy.

- 1 lb (raw) or 13 ounces (cooked) 90% lean ground beef
- 1 lb (raw) or 13 ounces (cooked) ground turkey with 7% fat, or chicken breast with skin, or dark meat chicken with half skin removed
- 3 ounces canned tuna, boneless salmon, or other oily fish without bones (use fish packed in water, don't use light tuna, and look for fish with the most fat you can find as long as it's not packed in oil)
- 3 large eggs
- 2 ounces beef liver
- 4 ounces plain yogurt
- 4 ounces cottage cheese
- 3 cups cooked white rice

- 15 ounces low-oxalate vegetables (e.g., 5 ounces broccoli, 5 ounces carrots, 5 ounces peas)

Nutritional analysis (more details available at [NutritionData](#)):

- 2222 grams cooked (4.9 pounds, 5.25 lbs raw)
- 2983 calories
- 299 grams protein (48% dry matter, 42% of calories from protein)
- 97 grams fat (16% dry matter, 29% of calories from fat, 32 grams of fat per 1,000 calories)
- 211 grams carbohydrates (34% dry matter, 29% of calories from carbohydrates)
- 2.9% dietary fiber
- 8,887 mg omega-6 fatty acids, 1,655 mg omega-3 fatty acids (ratio 5.4:1)

Variations:

- This recipe includes both poultry and beef. If you prefer to make separate batches, you can use the same amount of poultry or beef and divide the amounts of everything else in half, or double the amount of poultry or beef per batch, leaving everything else the same. Similarly, you could use yogurt in one batch and cottage cheese in another.
- You can use whole milk, low-fat, or nonfat dairy products. Use lower-fat products for older dogs and those prone to pancreatitis or digestive upset. Younger, more active dogs will do better with higher-fat products.
- If you are feeding canned salmon or other oily, boneless fish (not tuna), you can increase the amount of fish in the recipe to 6 ounces and decrease the number of eggs to 2, if preferred.
- You can mix and match various low-oxalate vegetables as you want. Fresh or frozen vegetables are better than canned, which may be high in sodium. Vegetables are best digested if cooked or pureed in a food processor, blender, or juicer.
- It's OK to use chicken or turkey liver with a poultry batch and beef liver with a beef batch, but don't substitute chicken liver for beef liver more than half the time. Note some people prefer to feed freeze-dried beef liver as treats instead, which is likely OK.
- It's fine to include some fruits in the diet, such as banana, apple, and melon. Blackberries, blueberries, small oranges, and prunes are group 3 (moderate oxalate, feed in very limited amounts only), but most other fruit group 4 (low oxalate).
- If you leave out any of the ingredients in the recipe, additional supplementation may be needed. For example:
 - If you don't feed fish, you will need to give fish oil for omega-3 fatty acids and kelp for iodine. Give an amount of fish oil that provides 100 to 150 mg EPA and DHA per 10 pounds of body weight daily for healthy dogs, up to 300 mg for dogs with cancer, kidney disease, or inflammation due to allergies, arthritis, or other causes. Do not use cod liver oil, which is high in vitamin D. See below for iodine supplementation.
 - If you don't feed dairy products, you should increase the amount of calcium added by about 15% and may also need to supplement with kelp for iodine (see below).
 - If you don't feed poultry, you'll need to provide omega-6 fatty acids from plant oils.
 - If you don't feed liver, the diet will be short on some minerals and B vitamins.
 - Omitting eggs will leave the diet short on choline with a little less fat.
 - Other nutrients may also be short if any foods are left out.

Amount to feed: See below for estimated amounts to feed adult dogs. The lower amounts are for senior, overweight, and less active dogs, while the higher amounts are for younger, more active dogs. Caloric needs can vary considerably between individual dogs, so always watch your dog's weight and adjust the amount fed as needed to keep your dog lean. If you find you are feeding less than the low amount shown below, you may need to add additional supplements to make sure your dog's nutritional needs are met.

- 5 pounds: feed 4.5 to 6 ounces (130 to 180 grams) daily (recipe will last 12 to 17 days)
- 10 pounds: feed 7.8 to 11 ounces (220 to 300 grams) daily (recipe will last 7 to 10 days)
- 20 pounds: feed 13 to 18 ounces (370 to 500 grams) daily (recipe will last 4 to 6 days)
- 30 pounds: feed 17 to 24 ounces (490 to 690 grams) daily (recipe will last 3 to 4.4 days)
- 40 pounds: feed 22 to 30 ounces (620 to 850 grams) daily (recipe will last 2.6 to 3.6 days)
- 50 pounds: feed 26 to 36 ounces (740 to 1,000 grams) daily (recipe will last 2.2 to 3 days)
- 60 pounds: feed 30 to 41 ounces (840 to 1150 grams) daily (recipe will last 1.9 to 2.6 days)
- 70 pounds: feed 33 to 46 ounces (950 to 1300 grams) daily (recipe will last 1.7 to 2.3 days)
- 80 pounds: feed 37 to 50 ounces (1050 to 1430 grams) daily (recipe will last 1.6 to 2.1 days)
- 90 pounds: feed 40 to 55 ounces (1150 to 1565 grams) daily (recipe will last 1.4 to 2 days)
- 100 pounds: feed 44 to 50 ounces (1240 to 1700 grams) daily (recipe will last 1.3 to 1.8 days)
- 120 pounds: feed 50 to 69 ounces (1420 to 1940 grams) daily (recipe will last 1.1 to 1.6 days)
- 140 pounds: feed 56 to 77 ounces (1600 to 2180 grams) daily (recipe will last 1 to 1.4 days)

Supplements:

- **Calcium Citrate (required):** add 2,400 to 3,000 mg calcium citrate to the entire recipe, or 500 to 625 mg per pound of food, or 30 to 40 mg per ounce, to provide a calcium to phosphorus ratio between 1:1 and 1.3:1. Calcium must be mixed in thoroughly so that the same amount will be given with each meal, or it may be easier to divide up the amount and add at mealtime. Sample products:
 - [Now Foods Calcium Citrate Powder](#): The label says that there are 630 mg calcium per 1.5 level teaspoon (3 grams), but the label is wrong. One level teaspoon of calcium citrate powder weighs 3 grams and provides 630 mg calcium citrate. Add 3.5 to 5 teaspoons calcium citrate powder for the entire recipe, or 3/4 to 1 level teaspoon per pound of food.
 - [Swanson Calcium Citrate Powder](#): 350 mg calcium per scoop, so add 6.3 to 8.5 scoops for the entire recipe, or 1 scoop per 250 to 350 grams (9 to 12 ounces) of food.
- **Magnesium (recommended):** This diet is a little short in magnesium (about 70 mg for the entire recipe), and dogs with calcium oxalate stones do better with added magnesium, such as 3 to 5 mg per pound of body weight daily, divided between meals. Too much magnesium can act as a laxative, so start small and increase gradually. Magnesium can be added at mealtime, or mixed in thoroughly with the whole recipe. Sample products:
 - [Food Science of Vermont Magnesium Aspartate](#): 50 mg magnesium plus small amounts of niacin and vitamin B6 (which is also considered good for calcium oxalate stones) per capsule
 - [Rugby Chelated Magnesium](#): 27 mg magnesium per tablet
 - [Now Foods Magnesium Citrate Powder](#): 315 mg magnesium per 1/2 level teaspoon
- **Vitamin E (required):** Give 1 to 2 IUs per pound of body weight daily (or can give more less often). Vitamin E can be given at mealtime or added to the recipe if it will not be stored more than a couple of weeks.
 - [Solgar Liquid Vitamin E](#): with mixed tocopherols (ideal): 20 IUs per drop
 - [Now Foods Vitamin E Liquid](#): 15 IUs per drop, also available in [1 oz size](#)
- **Iodine:** (optional) It is hard to know how much iodine is in a homemade diet. This supplement may not be necessary since the recipe includes saltwater fish and yogurt (fish is very high in iodine and yogurt is somewhat high). Give no more than 100 mcg daily for a 10-pound dog, 180 mcg for a 25-pound dog, 300 mcg for a 50-pound dog, or 500 mcg for a 100-pound dog daily. Iodine can be added at mealtime or to the entire recipe. Sample products:
 - [Now Foods Kelp](#): 150 mcg iodine per tablet
 - [Now Foods Potassium plus Iodine](#): 225 mcg iodine per tablet
 - [Now Foods Kelp Powder](#): 135 mcg iodine per level scoop
 - [Nature's Life Icelandic Kelp](#): 225 mcg iodine per tablet
 - [Monica Segal Kelp](#): 1150 mcg iodine per teaspoon
- **Lysimachia-3:** pulsed, to help prevent and treat calcium oxalate stones as described in the [Supplements](#) section above. Add at feeding time. Required if you are trying to dissolve existing stones, but can be pulsed

to prevent future stones from forming. If your dog has never formed stones, you might be able to get away with not using this supplement.

Resources

K9KidneyDiet (Yahoo group), discussion group that deals with calcium oxalate stones as well as kidney disease. <https://groups.yahoo.com/neo/groups/K9KidneyDiet/info>

Calcium citrate powder from NOW Foods (also available in tablet and capsule form). Sold in natural food stores and online. Available at Amazon.

Oxalate Content of Foods:

- **The Oxalate Content of Food** – <http://www.denvernephrlogy.com/wp-content/uploads/2012/12/Oxalate2008.pdf>
- **Dietary Changes to Prevent Oxalate Stones** – https://mydoctor.kaiserpermanente.org/ncal/Images/Dietary%20Changes%20to%20Prevent%20Calcium%20Oxalate%20Stones_tcm75-194243.pdf
- **Oxalate Status Food Lists** - <http://www.lowoxalate.info/recipes.html>
- **Oxalates in foods** - <http://www.whfoods.com/genpage.php?tname=george&dbid=48>

[*The Low Oxalate Cookbook: Book 2*](#), edited by Joanne Yount and Annie Gottlieb. VP Foundation, 2005.

[Lysimachia-3](#) from **Seven Forests**. Available online and through veterinarians.

[Potassium Citrate Capsules](#) from Nature's Pharmacy.

Probiotics:

- [Nature's Sunshine Probiotic Eleven](#) (available at [Amazon](#))
- [Sedona Labs Iflora](#) (available at [Amazon](#))
- [VSL#3](#) (also available at [Amazon](#)).

pH Test Strips:

- [Solid Gold pH test strips](#)
- [Micro Essential Laboratory pH test strips](#)

[Cushing's Disease \(Hyperadrenocorticism\)](#)

References

[Minnesota Urolith Center](#) at the University of Minnesota College of Veterinary Medicine

- [Canine Calcium Oxalate Uroliths](#)
- [Management of Mixed or Compound Uroliths Containing Calcium Oxalate and Struvite in Dogs](#)
- [Oxalate degrading bacteria in dogs](#) (ongoing study)

General References:

- [Oxalate Bladder Stones in the Dog](#)
- [Urolithiasis – Leaving No Stone Unturned](#)
Dennis J. Chew DVM, Diplomate ACVIM; The Ohio State University College of Veterinary Medicine, Columbus, Ohio USA, et. al. (Original site no longer available; [contact me](#) if you need a copy.)
- [Calcium Oxalate Urolithiasis in the Canine Patient](#)
- [Calcium Oxalate Urolithiasis](#)
Kelly Gisselman, DVM, Cathy Langston, DVM, DACVIM, et al
- [Experience with thiazide diuretics in calcium oxalate urolithiasis](#)
- [Effects of hydrochlorothiazide and diet in dogs with calcium oxalate urolithiasis](#)
- [Canine uroliths: Frequently asked questions and their answers](#)
- [Use of laser lithotripsy to treat urocystoliths in dogs: current status](#)
- [Fluid intake and epidemiology of urolithiasis](#)

Nutrition and Calcium Oxalates:

- **Nutritional Management of Canine Urolithiasis** (Stevenson, Rutgers) from the Encyclopedia of Canine Clinical Nutrition
- [Associations between dietary factors in canned food and formation of calcium oxalate uroliths in dogs.](#)
- [Association between dietary factors and calcium oxalate and magnesium ammonium phosphate urolithiasis in cats.](#)
- [Magnesium and vitamin B6 for kidney stone prevention](#)
- [Impact of Urine Sodium on Urine Risk Factors for Calcium Oxalate Nephrolithiasis](#)
- [The influence of dietary minerals on calcium oxalate kidney stones](#)
- [Vitamin C Supplementation and Urinary Oxalate Excretion](#)
- [Dietary and Holistic Treatment of Recurrent Calcium Oxalate Kidney Stones: Dietary Vitamin C in Beverages](#)
- [Ascorbic Acid Supplements and Kidney Stone Incidence Among Men: A Prospective Study](#)
- [Kidney stones: treatment and prevention](#)
- [Effect of Different Cooking Methods on Vegetable Oxalate Content](#)
- [Nutrition and Urolithiasis in Dogs and Cats](#)
- [Reduction of oxaluria after an oral course of lactic acid bacteria at high concentration.](#)
- [Vitamin C and Calcium Oxalate Stones](#)
Great quote: "I have lost count of the number of pets from which I have surgically removed stones that were on diets, supplements, or other therapies designed to prevent the stone formation of the type I removed."

Water and Calcium Oxalates:

- [Water hardness and kidney stones](#)
- [Calcium nephrolithiasis: effect of water hardness on urinary electrolytes](#)
- [Comparative study of the influence of 3 types of mineral water in patients with idiopathic calcium lithiasis](#)

Urolith Distribution:

- [Current Trends in Urolith Submissions in Canada](#)
- [Analysis of 36,032 canine cases shows decline in struvite uroliths](#)
- Analysis of 4495 canine and feline uroliths in the Benelux. A retrospective study: 1994–2004
P. Picavet¹, J. Detilleux², S. Verschuren¹, A. Sparkes³, J. Lulich⁴, C. Osborne⁴, L. Istasse⁵ and M. Diez⁵
(private copy)