

Urinary Stone-Forming by Puppies

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Introduction

In 1999, the Urinary Stone Center of the U. Minnesota School of Veterinary Medicine introduced for veterinarians their latest textbook bursting with some 25 years of experience and data accumulated from an astonishing 77,000 canine urinary stones.⁽¹⁾ The textbook includes information on puppies little or none of which had been previously available. This article reports the all-breed puppy data plus specific comments on Dalmatian puppies from the splendidly informative chapter on urates by its noted author, Joseph W. Bartges, DVM, PhD (featured speaker at the 1992 Annual DCA Educational Seminar and whose videotape on stone-forming continues as the alltime top-requested one in the DCA Lending Library). Closing this article are provocative and experimental experiences with two Dalmatian litters, one in the U.S. and one in Canada. Except where otherwise noted, all data and graphs have been extrapolated from "*The ROCKet Science of Canine Urolithiasis*," published as the January 1999 volume of *The Veterinary Clinics of North America*.

For detailed overviews on Dalmatian stone-formers of all ages, readers are reminded of the series of generalized teaching articles on the DCA homepage (<http://www.thedca.org>).

Dalmatian Stone-Forming vs. Other Stone-Forming Breeds

Puppy information becomes more meaningful when compared to the following aspects of adult Dalmatian stone-forming.

Puppies grow up to become adults so remember for all Dalmatian puppies too, they are the *only breed of dogs* forming abnormal urate crystals/stones because of a genetic defect in urine formation by their livers and kidneys.^(2,3) The two other species with the genetic defect are humans and apes. Interestingly, urates form in other breeds especially Bulldogs, Yorkies, Miniature Schnauzers and Shih Tzu but for different reasons than in Dalmatians.

Every urinary crystal/stone is made of a specific mineral, sometimes several together, so it is - firstly - identification by assay of that mineral which directs treatment to the correct path for success in any breed's stone-former, adult or puppy. The most common in all other breeds are *struvites* (also known as *magnesium phosphates* or by other synonyms) frequently found with urinary tract infections and also found in some Dalmatians either alone or in combination with urates. But it is Dalmatians' inborn potential to form *urate stones* which veterinary articles and textbooks have incriminated as a breed-specific defect since 1938.⁽²⁾ Of all stone-forming Dalmatians, purine/urates accounted for 95 percent of all stones assayed.⁽⁴⁾ It remains unknown why some Dalmatians have the breed's inborn potential activated to become "overt" urate stone-formers while others, even littermates, do not and remain symptom-free their entire lives.

Many are confused between the terms "purines" and "urates." Purines are akin to an overriding family name with the type of urate subclassified to family individuals so that all urates fall under the group name of "purines." One Dalmatian purine stone is not a urate and that is "*xanthine*" which is formed by overdosage of the anti-urate drug, allopurinol.⁽⁵⁾ Some terms appearing in this article necessarily state "purine/urates" when the data included xanthine but cite only "urates" when xanthine data was not included. Other important reminders are:

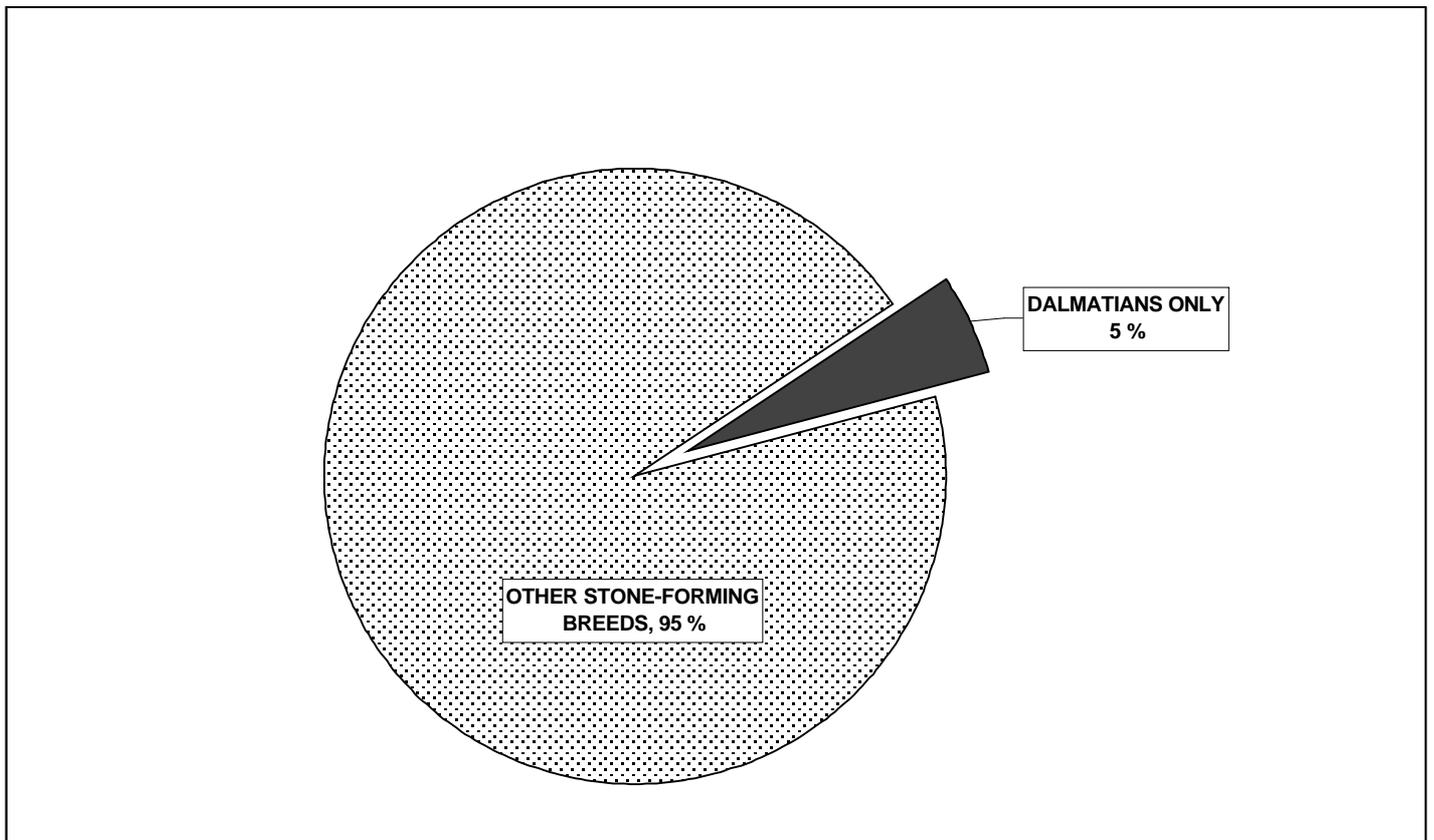
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- Urates thrive in an abnormally acidic urine, that is *below* Dalmatian "normal" of pH 6.5 to 7.0
 - Struvites are the exact opposite in that they thrive in an abnormally alkaline urine, that is *above* Dalmatian "normal" of pH 6.5 to 7.0
 - Crystals are early stages of stone-formation and, left untreated, usually "grow up" to become stones.
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Every new Study Group article reactivates the question, as will this one, "*How many Dalmatians throughout the entire breed become stone-formers?*" No breed-wide incidence of overt, confirmed Dalmatian stone-forming has ever been attempted anywhere nor will the elusive statistic probably ever be obtainable much as that data would be invaluable. Highly questionable "guesstimates" pop up within the fancy and even by veterinarians but the Study Group has yet to find one of these breed-wide conjectures acceptable. The procedural requirements to authenticate breed-wide incidence are simply too prohibitive to gather unquestionably-accurate, scientifically-credible and statistically-significant data without contaminating variables. What is known, though, is *the ratio* of stone-forming Dalmatians compared to *other* stone-forming dog breeds.

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Graph No. 1 - DALMATIANS vs. OTHER STONE-FORMING BREEDS (53,951 URINARY STONES, ALL GENDERS, ALL AGES)

Ten Years' Data by Minnesota Stone Center;
Adapted from personal communication to DCA Study Group



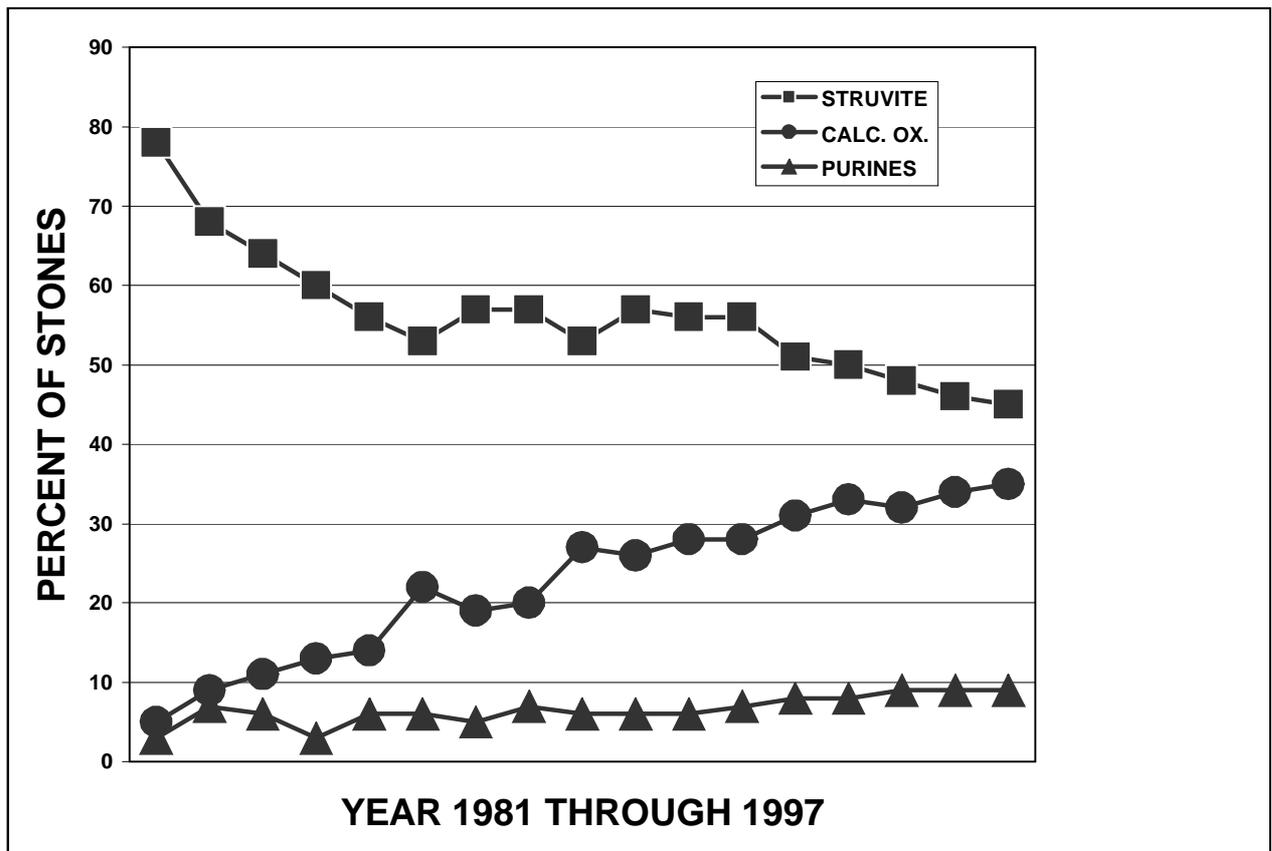
Dalmatians have hovered pretty unchangingly between 4 and 5 percent of all other stone-forming dog breeds for over a decade according to the databanks of the two U.S. vet centers specializing in this canine health problem.^(3,4) Although these data reflect only those Dalmatian stones sent to the two veterinary centers and do not include Dals diagnosed and treated exclusively by their local vet, the percentages are statistically significant, based on 54,000 stones identified by the Minnesota Stone Center in Graph 1.

Dalmatian purine/urate stones (the type most frequently formed by our breed) remain fairly constant in incidence but other types of stones are drastically changing in all breeds, as seen in Graph 2.

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Graph No. 2 - SEVENTEEN YEAR TREND IN URINARY STONES (ALL DOG BREEDS, ALL GENDERS, ALL AGES)

Adapted from 1999 textbook citing 25 years with 77,000 stones by Minnesota Stone Center.



Struvite (nicknamed "infection stones" because they so often accompany urinary tract infections caused by the stone-forming bacterial species *Staphylococcus* and *Pseudomonas*) remains the number one abnormal urinary crystal/stone assayed in other breeds, as it is in the all-breed puppy graph following. However, note that graph 2 shows the incidence of struvite is falling significantly. The textbook suggests this is probably because more general practice vets are knowledgeably diagnosing and treating this type of stone. In second place of frequency, calcium oxalate has climbed alarmingly and also can appear in puppies as seen in Graph no. 3. Remember any Dalmatian including puppies forming calcium oxalate, should not be given vitamin C and foods containing it such as citrus fruits because ascorbic acid is a chemical precursor of calcium oxalate.⁽⁵⁾

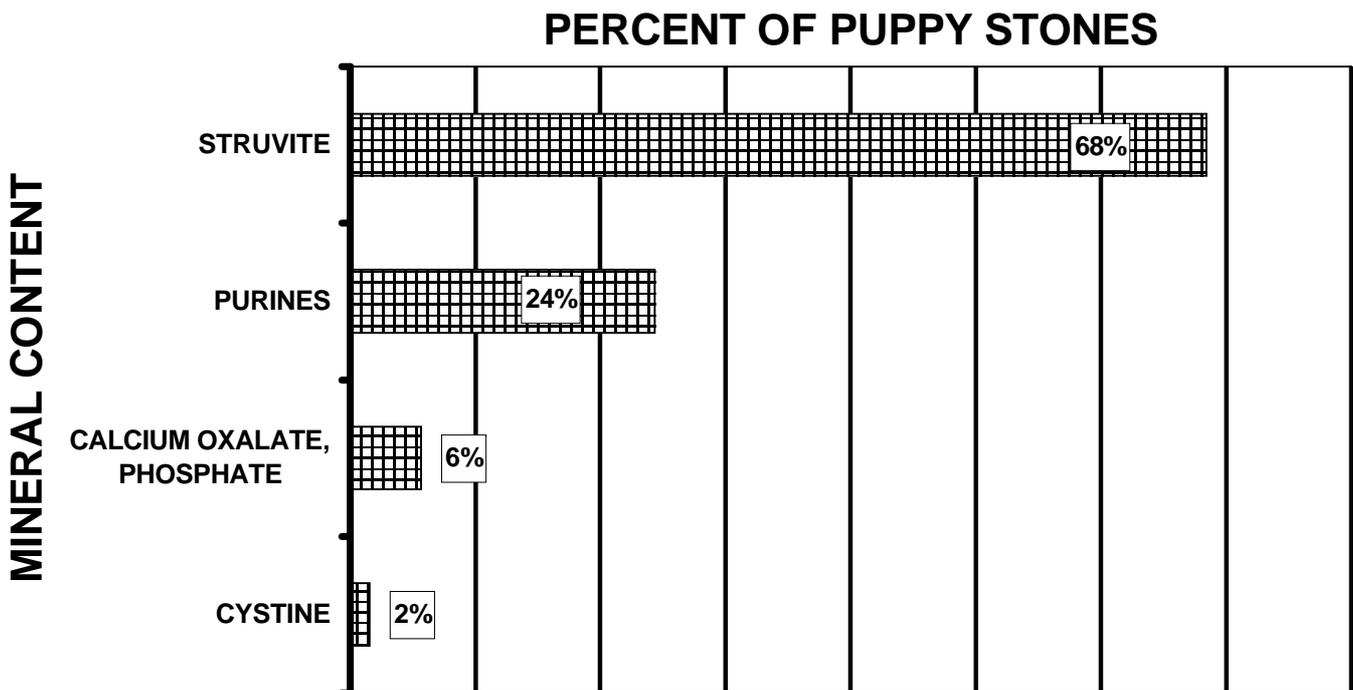
Based on type-of-stone, Graph 2 confirms how all-breed purine/urates also continue in a relatively unchanging plateau, not just those of Dalmatians. However, the DCA Study Group is receiving reports from owners that struvite and calcium oxalate crystals/stones are being formed by some Dalmatians though not as drastically as in the chart. Because insoluble minerals other than urates are precipitating out in Dalmatian urine, it emphasizes why the type of crystal/stone being formed must

be identified quickly and accurately. False identification, or if the stone-forming Dalmatian is presumed to be creating breed-specific urates without a confirming assay (when it is actually forming another type), can worsen the dogs status. Why? Treatment of some minerals can be the exact opposite of others and thereby can worsen a misdiagnosed stone-forming Dalmatian.

Abnormal Urinary Crystals / Stones in Puppies

Graph No. 3 - CONTENT OF 849 PUPPY URINARY STONES (ALL BREEDS, ALL GENDERS)

Adapted from 1999 textbook citing 25 years with 77,000 stones by Minnesota Stone Center.

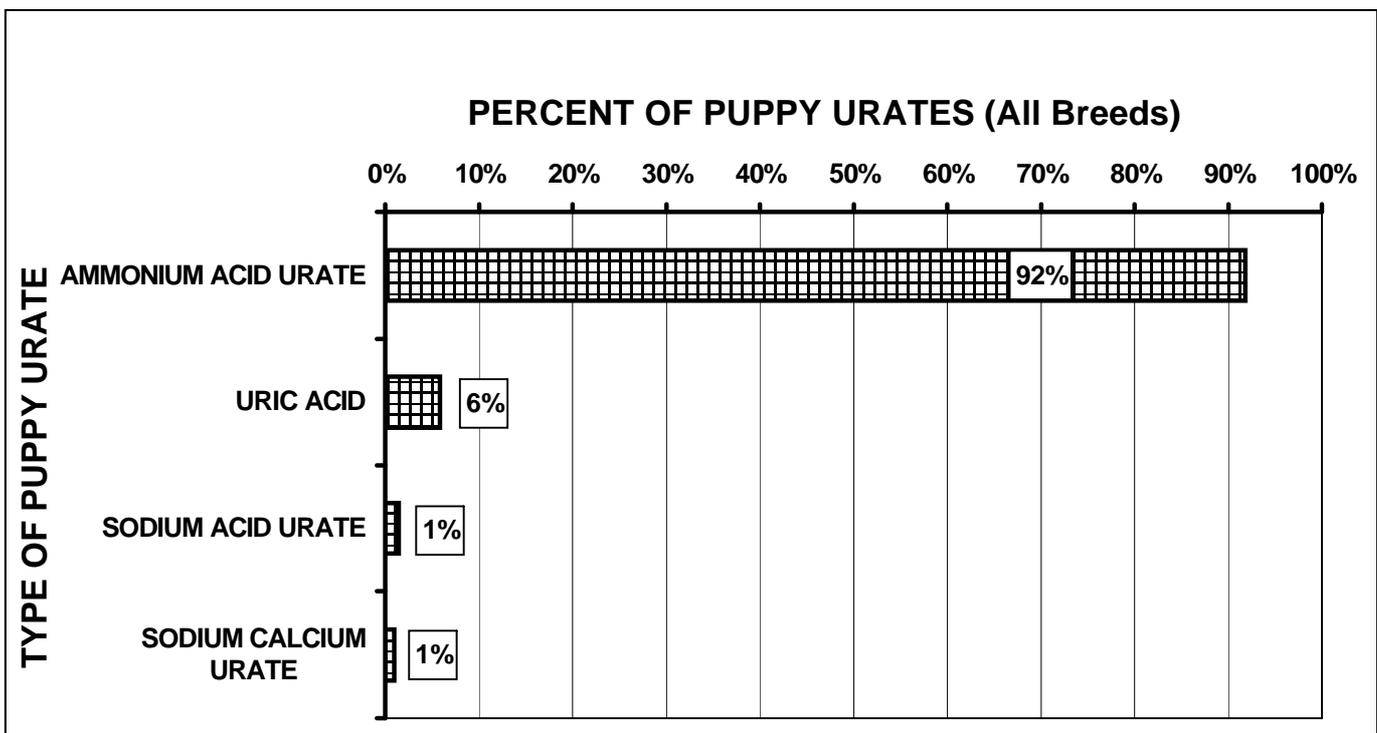


Struvite as in the more sweeping data of graph 2 again is the one most frequently reported for any breed of puppies. Considering how prone puppies are to urinary tract infections, this is not surprising and may be one explanation for the "infection" crystals/stones to be so prevalent. Urates though in second place are markedly lower in incidence - only about one-third that of struvite. Had the textbook's data been broken down by breed (which was not), Dalmatian puppy data probably would have paralleled that of adult Dalmatians, namely urates as number one with struvite number two.⁽⁴⁾ Nonetheless, this all-breed graph still reveals any puppy, Dalmatians included, is not exempt from abnormal urinary crystals/stones. Because both struvites and calcium oxalate have been reported in adult Dalmatians, the DCA Study Group cautions these two minerals cannot be dismissed if Dalmatian puppies are stone-formers. We again emphasize the procedural necessity of, first, accurate identification of the crystals/stones for

correct and effective treatment.

Graph No. 4 - TYPE OF PUPPY URATES (207 STONES, ALL BREEDS, ALL GENDERS)

Adapted from 1999 textbook citing 25 years with 77,000 stones by Minnesota Stone Center.



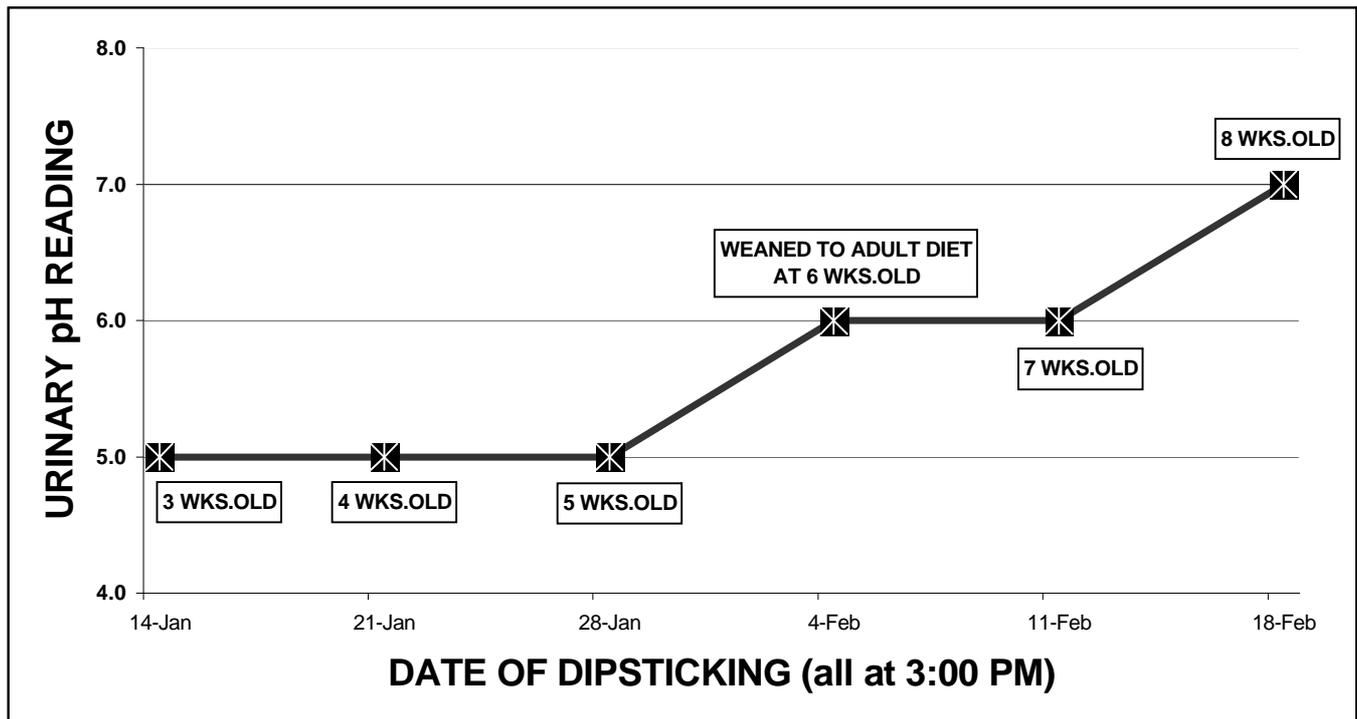
Graph 4 matches that of adult urate-forming Dalmatians⁽⁴⁾ - the one most frequently assayed for all-breed puppies was ***ammonium acid urate***. The textbook notes this urate is being formed by 66 breeds of dogs although Dalmatians are the only breed with the inborn urate-forming defect. Happily, ammonium acid urate stones are very responsive to knowledgeable non-surgical treatment and there now are some 15 years of accumulated information providing insightful knowledge about this specific mineral. One purine conspicuously missing in this puppy chart is xanthine - probably because this mineral is created by overdosage of the anti-urate drug, allopurinol, which is rarely used in puppies.

Equally of interest are Dr. Bartges' comments about puppies in his textbook chapter on urates, "***It is our observation that substantially more Dalmatian puppies have urate*** [crystals in their urine] ***than develop urate*** [stones]." But probing further into explanations, he cautions it is unknown why some puppies with crystals do not form stones whereas others do. The Study Group notes this inconsistency is identical in mature Dalmatians some of which may form crystals but never stones while other adults form stones without crystals...still another question mark in the inventory of perplexing unknowns about this urinary problem.

Dr. Bartges tells of a small series of 5 Dalmatian puppies, not littermates, tracked after they were

confirmed with urate crystals. The abnormal crystals persisted while they necessarily were on a high protein puppy chow. The crystals disappeared when they were shifted from the puppy formulation to an adult one. Followed until they were five years of age, none of these 5 Dalmatian puppies became an overt adult stone-former. Despite this encouraging observation, please note only 5 Dalmatians were followed and their status cannot be projected into any kind of generalization nor complacency for all stone-forming puppies, would that it be otherwise. Still, it is reassuring to learn that some puppies confirmed with abnormal urinary crystals may not progress into puppies with stones. Evidence of this is seen in the following two experimental Dalmatian litters, when some puppies reached maturity without symptoms although crystals/stones in others continued into adult maturity and these Dalmatians were placed on preventative anti-urate diets and allopurinol.

Graph No. 5 - URINARY pH READINGS OF DALMATIAN PUPPIES
COURTESY OF MARION MITCHELL, BREEDER (NEW MEXICO)
Litter of 4 Females / Dipsticking at Seven Day Intervals



Family history of the dam revealed she had had 3 stone-forming littermates, 1 male of which had such severe stone-forming that his ureter (one of two carrying urine from kidneys to bladder) burst. This puppy survived with treatment.

The dam and puppies in this experimental all-bitch litter drank New Mexico tap water and were fed a lamb-and-rice food formulation. Mrs. Mitchell observed the puppies usually dipsticked to an acidic urinary pH while nursing but, as they matured, the pH started climbing towards adult normal of pH 7.0. Before weaning, she reported the dam "*...doesn't nurse them that often and certainly not on a*

regular basis." All of the puppies' urine was visibly clear except for 1 puppy who infrequently showed cloudy urine which would uneventfully clear before erratically recurring again. This bitch matured without any subsequent signs of overt urinary stone-forming and remains so at her current age of two years.

Intrigued by her pH diary of the litter, Mrs. Mitchell at one point added two more daily dipstickings - one early AM and one evenings. She wrote, "***I found that around 9:00 AM the pH for every puppy was pH 7. By afternoon, it dropped to pH 5.0 and after 6:00 PM, it rose again to pH 6.0. These fluctuations didn't seem to do with anything in particular.***"

Follow-up of the Dalmatians two years later revealed neither the dam nor any of the 4 littermate bitches have ever shown any signs of overt urinary stone-forming nor, for that matter, any urinary tract infections.

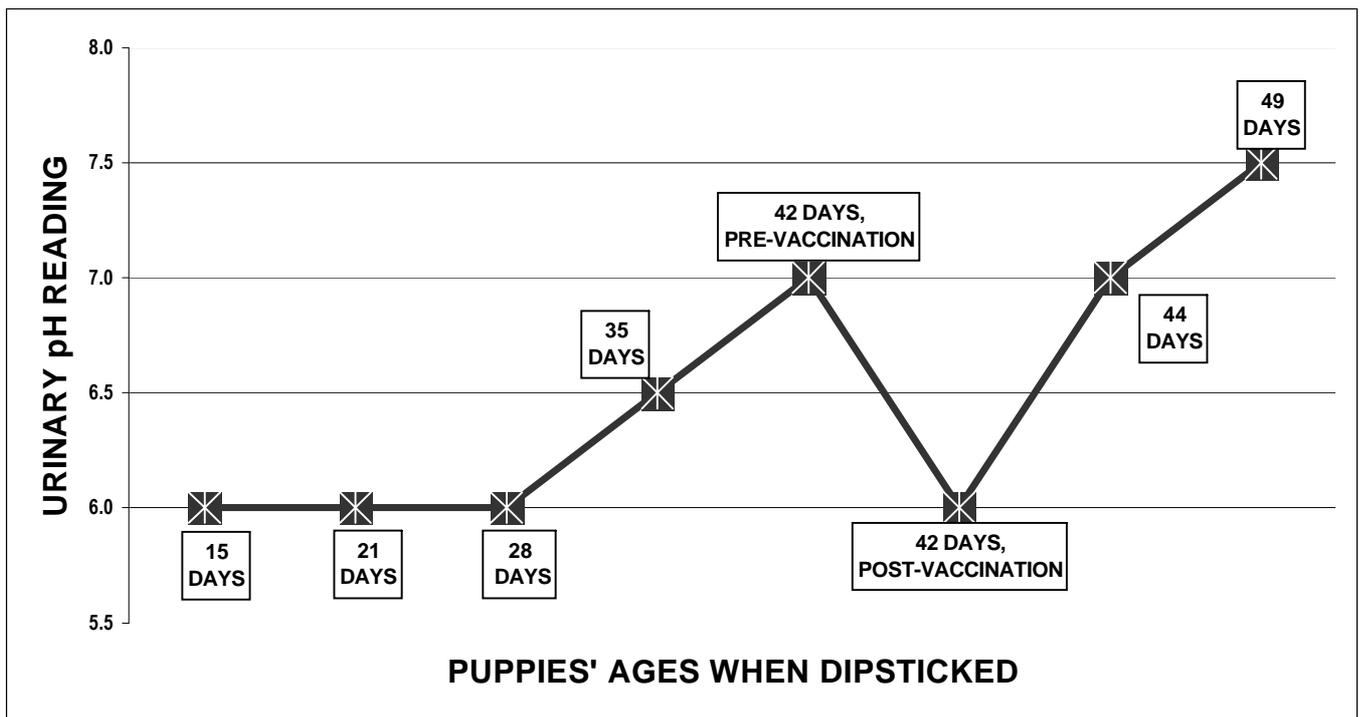
The second experiment with Dalmatian puppies came from a Canadian breeder who originally had consulted with the Study Group when in a previous litter 1 male obstructed approximately one week after weaning and was treated to open up his urinary pathway. He was euthanized at four weeks of age after again obstructing. Necropsy showed only an unsurprising mild irritation of the bladder. The puppy's stone sent to the Minnesota Center was assayed as a urate. Three of his 6 male littermates also were forming urate crystals and placed on distilled water but without changing their adult food formulation. They climbed to canine normal pH 7.0 at six weeks of age. One of these males continued to form abnormal urinary crystals as he matured and is currently on a low-protein food formulation plus distilled water. Another male littermate also continued to form abnormal crystals and the owner's vet placed him on lifetime preventative allopurinol together with an adult turkey-and-barley food formulation. A third male experienced noticeable discomfort at about one year of age. The vet suspected an unpassed stone and prescribed the prescription anti-urate diet u/d and allopurinol. The discomfort subsided but this male showed an ongoing plateau of pH 5.0 and was placed by his vet on lifetime allopurinol, distilled water and a low-protein lamb-and-rice food formulation although no crystal nor stone was ever assayed for this Dalmatian. The only bitch in the litter matured without urinary symptoms and was never tested. To date, none of the three stone-forming males have ever obstructed nor has any of the balance of the litter, 3 non-symptomatic males and 1 female. At five years of age, all surviving 7 adult Dalmatians are living happy and uneventful lives with their owners.

The next litter was a breeding of the same dam but by a different sire. At the suggestion of the Study Group, the dam was provided only bottled distilled water almost from the moment of tie through whelping and nursing of the puppies. The puppies, 4 males and 1 bitch, also drank only distilled water. The dam was fed ***Nutro Natural Choice Lamb & Rice*** and received ***DermCaps*** throughout pregnancy and lactation. The puppies were weaned onto the same food formulation and received kelp supplementation as did the dam. At three years of age, no reports of any urinary stone-forming in this litter have been reported back to the breeder.

Graph 6 is of the most recent and third litter by the same dam but again by a different stud consisting of 5 males and 3 bitches. As in the previous litter, the dam and puppies received only distilled water and were fed ***Nutro Natural Choice Lamb & Rice***. At 14 months old, the breeder writes all puppies are "***normal and healthy and none have experienced urinary problems.***"

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Graph No. 6 - URINARY pH READINGS OF DALMATIAN PUPPIES COURTESY OF ANONYMOUS BREEDER (CANADA) Litter of 8 Puppies, Males & Females



After the dreaded obstruction of the one previous male, not one puppy in 2 successive litters showed any evidence of crystal/stone formation much less obstructing. The pattern of acidic pH when the puppies were young and then rising as they became older parallels that of Marion Mitchell's litter. The graph shows two dipstickings at 42 days of age, before and after vaccinations. The drop in pH is the reverse of 1 previous litter which dipstickings just the opposite - urinary pH had spiked after vaccines were given. The reason for the pH spiking vs. drop in the two litters is unknown.

Because Canadian mass media always trumpet objections to "acid rain," the articles added to the Study Group's suspicions about their tap water and resulted in the recommendation to try bottled distilled water, the only change in the food-water regimen. An anecdotal report but surely a welcome difference to the first litter with the 1 euthanized male. The breeder wrote, certainly not ignoring the big question mark about the different stud in successive breedings, "...*water* [seems to be] *a major contributing factor to stone forming*. [It] *was really the only variable in our three litters, the first and problematic litter being weaned on tap water, the other two problem-free litters raised on exclusively distilled. Otherwise, same food and supplements, same vaccination and weaning protocol, same dam...Still anecdotal with only three litters but I KNOW* (breeder's emphasis) *our regional water supply is 'rich' in minerals...my father was born and raised on a farm less than a mile from our home and he remembers vets removing stones the size of baseballs from their workhorses!*"

The patterns of the New Mexico and Canadian puppies' urinary pH are fascinating and "firsts" for the Study Group and our accumulating knowledge of Dalmatian stone-forming. We are indebted to

these two dedicated breeders for taking on the dipsticking chore and conscientiously relaying their results and observations. The information is provocative at this point of premature knowledge about puppy stone-forming despite its significance remaining unknown with such little data. Dipsticking puppies' urine is, at best, difficult starting with almost insurmountable problems to obtain the samples much less without presence of contaminants. Other questions about monitoring puppies also occur. For example:

- What is "normal" urinary pH for nursing vs. weaned puppies vs. adult Dalmatians?
- What is the influence of purine and protein levels of mother's milk and of diets after weaning to solid food?
- Do supplements for the dam or puppies contain stone-forming chemicals?

Nonetheless, these two experimental dipstickings suggest how determining puppies' urinary pH may provide helpful health information of the litter. The Dalmatian community owes a vote of thanks to these two pioneering ladies!

Special Recipes for Urate-Forming Puppies

Two recipes for puppies confirmed with urate crystals/stones end Dr. Bartges' chapter both based on Hill's canine u/d[®] Prescription Diet, the only commercially-available food formulation for confirmed urate stone-formers as of the writing of this article.

PUPPY RECIPE No. 1

1 cup of dry canine u/d[®] Prescription Diet
1 tsp. dicalcium phosphate
1 cup of cottage cheese
Multivitamin and mineral supplements

Percent nutrients of dry matter, recipe 1:

| | |
|------------|------|
| Protein | 30.5 |
| Fat | 19.5 |
| Calcium | 1.0 |
| Phosphorus | 1.0 |
| Magnesium | 0.02 |
| Sodium | 0.6 |
| Potassium | 0.5 |

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PUPPY RECIPE No 2

1 cup of dry canine u/d[®] Prescription Diet
¾ tsp. of dicalcium phosphate
2 hard-boiled eggs
Multivitamin and mineral supplements

Percent nutrients of dry matter, recipe 2:

| | |
|------------|------|
| Protein | 17.6 |
| Fat | 27.1 |
| Calcium | 1.1 |
| Phosphorus | 1.0 |
| Magnesium | 0.02 |
| Sodium | 0.4 |
| Potassium | 0.6 |

Readers are reminded pet vitamins are in a base of dessicated liver, perhaps the worst purine-yielding protein to give to Dalmatians. We endorse the use of multivitamin & mineral supplements especially with distilled water but recommend the alternative of standard human children's vitamins. Follow their dosage recommendations by age of human child (with their approximate weights) to the paralleling weight of the Dalmatian. Vitamins should never be given on an empty stomach.

Summary and Conclusions

1. Some puppies, including those of Dalmatians, form abnormal urinary crystals/stones.
2. Preliminary veterinary experience suggests Dalmatian puppies forming abnormal crystals may rarely progress into stone-forming puppies. Others, however, may. It is unknown why some puppies do and others do not, as is the identical and erratic pattern in adult crystal-forming Dalmatians.
3. Tracking of a small group of 5 urate crystal-forming Dalmatian puppies showed they did not mature into adult stone-formers by five years of age, the end of the follow up.
4. Two litters were experimentally dipsticked by DCA members to determine Dalmatian puppy urinary pH. Both anecdotal results suggest nursing Dalmatian puppies test with a very acidic urinary pH. Some of the puppies approached adult normal pH as they were weaned and matured into senior puppies. Abnormal crystal/stone forming persisted in others who were placed on a successful regimen of anti-urate diets and allopurinol. It is unknown what influence mother's milk may have exerted during nursing nor if the urinary acidity before weaning is normal or abnormal for that age of puppies.
5. A choice of two diets for urate-forming puppies is cited from the veterinary textbook.

References

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- (5) *National Bulletin to Regional DCA Clubs*, March 1995: Owners of Stone-Forming Dalmatians: Be Aware of Vitamin C.
- (6) Ling, G.V., and co-authors: Xanthine-Containing Urinary Calculi in Dogs Given Allopurinol, *J. Am. Vet. Med. Assoc.* 1991, 198:1935-1940.
- (7) *Website of the DCA* at <http://www.thedca.org/dipstick.html> - Dipsticking to Monitor Stone-Formers.

From its creation some ten years ago, the DCA Study Group on Urinary Stones has evolved its information program for Dalmatian owners almost exclusively based on data and knowledge taught to the veterinary profession by two U.S. academic veterinary centers specializing exclusively in canine stone-forming.

We are indebted to Carl A. Osborne, DVM, PhD, creator and chief of the Minnesota Stone Center for his encouragement and enthusiasm which were and continue to be major motivations as the DCA Study Group constantly expands its ongoing information program about this breed-specific health problem. Gerald Ling, DVM, chief of the California center was also of immeasurable help during the formative years of the Study Group and his support was invaluable in setting trends of teaching for the Study Group.

We are especially grateful to Joseph W. Bartges, DVM, PhD for his patience and cooperation as the Study Group almost weekly contacts him for advice and insight. His concern with our beloved breed has been constant from our first meeting during his 1992 lecture as the annual DCA Educational Seminar to the present time. When he was Dr. Osborne's senior resident and completing his doctorate at the Minnesota Center, Dr. Bartges entrusted the Study Group with his irreplaceable original graphics in order to incorporate the images directly into the DCA videotape, an audiovisual technique which may account for its teaching excellence especially for x-ray evidence of stones and microscopic identification of abnormal urinary crystals. To this day, his invaluable veterinarianian friendship to our fancy is ongoing and undiminished.