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THE SCIENCE DOG

The Heart of the Matter

What is taurine-deficiency dilated cardiomyopathy (DCM), and how can dog owners prevent it? (Hint: It involves more than just grain-free foods.)

In mid-July 2018, the U.S. Food and Drug Administration (FDA) released an alert to veterinarians and pet owners regarding reports of increased incidence of a heart disease called canine dilated cardiomyopathy (DCM). This disorder is characterized by weakening of the heart muscle, which leads to a decreased ability of the heart to pump, and if untreated, to cardiac failure. The reported cases occurred in breeds that are not considered to be genetically predisposed to this disorder.

Further, a significant number of the dogs were found to have reduced levels of circulating taurine in their blood and have responded positively to taurine supplementation. It is speculated that these cases are related to the consumption of foods that negatively affect taurine status, leading to taurine-deficiency DCM. Foods containing high levels of peas, lentils, other legume seeds, and/or potatoes were identified by the FDA as potential risk factors. These ingredients are found commonly in foods that are formulated and promoted as "grain-free."

As these things go, there followed a lot of hype and a fair bit of hysteria in response. Let us avoid this type of reaction and instead look at the evidence: What do we currently know about the role of diet and taurine in the development of DCM in dogs – and how is it that "grain-free" foods have been recently targeted as a possible dietary cause?

*It's not the lack of grain, but the use – and likely, **overuse** – of ingredients used to replace grain as a carbohydrate source, that is being implicated in diet-linked DCM.*

WHAT IS TAURINE?

The nutrient taurine is a unique type of amino acid, called a beta-amino sulfonic acid. It is not

Know the Signs of Dilated Cardiomyopathy (DCM)

DCM is a disease of the heart, which causes the heart muscles themselves to weaken, which, in turn, causes reduces the ability of the heart to pump blood through the dog's body as it should. The heart becomes enlarged and flabby, and fluid begins to accumulate in the dog's lungs. As this condition progresses, it causes congestive heart failure.

Early signs of DCM include:

- Lethargy, decreased energy
- A persistent cough
- Any difficulty breathing, rapid or excessive breathing, or seeming shortness of breath
- Episodes of collapse
- Dogs may experience anorexia (chronic loss of appetite)

By the time signs like these are seen, the disease may already be fairly advanced. That's why it's important to make an appointment to see your veterinarian right away if your dog displays any of these signs, or more than one of these signs. Often, owners of middle-aged or senior dogs think that their dogs' symptoms are "just old age," but a quick diagnosis and treatment can restore an affected dog's quality of life to nearly normal – and extend the dog's life far past an untreated dog's prognosis.

Treatment usually involves medications that help the dog's heart to contract, slow his rapid pulse, help control the accumulation of fluid in his lungs, and dilate his blood vessels – all actions that will improve the heart's performance.

incorporated into proteins but rather is found primarily as a free amino acid in body tissues and circulating in the blood. Taurine has many functions, but two that are important for this discussion involve its role in normal heart function, and its presence as a component of bile acids, which are needed for fat digestion. Most animals obtain adequate taurine to meet their needs by producing it endogenously (in the body) from two other amino acids, methionine and cysteine.

This means that while most animals require taurine physiologically, most do not have a *dietary* requirement for taurine. The exception to this rule is the cat. Cats (but not dogs) always require a source of taurine in their food. If they do not have it, one of the diseases that they can develop (and possibly die from) is – you guessed it – DCM.

Taurine-deficiency DCM is well documented in cats. We also know quite a lot about the dietary factors that contribute to this disease in that species. In contrast, dogs (usually) do not require a source of dietary taurine. However, we know that some dogs still develop taurine-deficiency DCM. Why does this happen? The history of DCM in cats can help in untangling what may be occurring in dogs.

TAURINE-DEFICIENCY DCM IN CATS

Looking back, I cannot avoid a sense of déjà vu. In the early 1980s veterinarians began reporting increased incidences of DCM in pet cats. By 1987, a role for dietary taurine was suspected. In a seminal study, a veterinary researcher at UC Davis reported low plasma (blood) taurine levels in 21 cats with clinical signs of DCM.[1] When the cats were supplemented with taurine, all 21 completely recovered from the disease. This discovery led to a series of controlled studies that supported the existence of taurine-deficiency DCM in cats who were fed diets that contained sufficient concentrations of taurine.

What was going on?

It has to do with bile acids. Another role of taurine is the body is that it is necessary for normal bile acid function. Taurine is linked to bile acids in the liver to form bile salts. During digestions, these compounds are secreted into the small intestine, where they function to aid in fat digestion. Animals are very efficient at conserving the taurine that is secreted into the intestine by reabsorbing the bile salts back into the body further down the intestinal tract. This occurs through a process called "enterohepatic reutilization" and prevents a daily loss of taurine in the feces.

Herein lies the problem for cats with DCM: If anything happens during digestion that causes the degradation of the bile salt taurine or that inhibits its reabsorption into the body, more is lost in the feces. If this happens consistently, the cat will experience an increase in his or her daily need for dietary taurine. Simply put – if anything causes the cat to poop out more taurine-bile acid complexes (or their degraded by-products), the cat will be in danger of a taurine deficiency if a higher level is not provided in the diet.

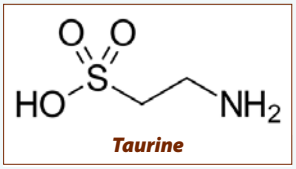
This is exactly what was happening in the cats with taurine-deficiency DCM – and is possibly what we are seeing today in dogs. The difference is that we know what diet factors caused taurine deficiency in cats during the late 1980s. These factors are not yet fully understood for dogs (but we can make a few guesses).

HERE IS WHAT WE KNOW

The studies with cats found that several dietary factors influenced taurine status.[2,3,4] These were the level and type of dietary protein, the amount and type of dietary fiber, and the degree of heat that was used during food processing. These factors could affect taurine status in three ways:

1 BILE ACID BINDING. Certain fibers and peptides (small protein chains) in the food can bind with bile salts the small intestine and make them unavailable for reabsorption into the body. This results in an increased daily loss

A Few Things About Taurine



Taurine

Taurine Is Needed For:

- *Healthy heart function*
- *Component of bile acids*
- *Retinal function*
- *Reproductive health*

Dietary Risk Factors for Reduced Taurine Status

- *Low-protein diet (limited taurine precursors)*
- *Heat-damaged for poor-quality protein sources*
- *High dietary fiber (i.e., rice bran, beet pulp, cellulose)*
- *Lamb and rice diets (speculated)*
- *Plant-based protein sources (peas, lentils, legumes) (speculated)*

Possible Risk Factors for Taurine-Deficiency DCM

BREED:	SIZE:	DIET:
• *Amer. Cocker Spaniel*	• *Large-breed dogs*	• *Factors that reduce taurine production*
• *English Setter*	• *Dogs with slower metabolic rates*	• *Factors that increase taurine-degrading microbes in the intestine*
• *Golden Retriever*		• *Factors that reduce bile acid production*
• *Labrador Retriever*		
• *Newfoundland*		
• *St. Bernard*		

of taurine in the feces and a subsequent increase in daily taurine requirement to replace that loss.

2 INCREASED MICROBIAL DEGRADATION. Thermal processing of protein (extrusion or canning) can lead to the production of Maillard products – complexes of sugars and amino acids that are poorly digested in the small intestine. The undigested complexes travel to the large intestine and provide an intestinal environment that favors increased numbers of taurine-degrading bacteria. An increase in these bacterial populations reduces the proportion of taurine that is available for reabsorption and reuse by the body.

3 REDUCED TAURINE AVAILABILITY. Taurine is found naturally in animal-based proteins but is not found in plant-based protein sources. Therefore, providing diets that include a sufficient level of high-quality animal proteins (that are not heat damaged) should ensure adequate taurine intake.

However, protein that is of low quality or that has been excessively heat-treated will be poorly digested, reducing the availability of taurine and of its precursor amino acids, cysteine and methionine.

In the early 1990s, in response to this new information regarding the interaction of dietary factors and taurine status in cats (and their relationship to DCM in cats), the Association of American Feed Control Officials (AAFCO) increased the recommendations for dietary taurine in extruded and canned cat foods.

SO, WHAT ABOUT DOGS?

Unlike the cat, dogs who are fed diets containing adequate levels of protein should be capable of synthesizing enough taurine from the two amino acid precursors, cysteine and methionine, to meet their needs. Therefore, a requirement for dietary taurine has not been generally recognized in dogs.

However, there is evidence – evidence that we have had for at least 15 years – that certain breeds of dogs, and possibly particular lines *within* breeds, exhibit a high prevalence of taurine-deficiency DCM. Genetically predisposed breeds include the American Cocker Spaniel, Golden Retriever, Labrador Retriever, Saint Bernard, Newfoundland, and English Setter.[5,6] Although the exact underlying cause is not known, it appears that some breeds have either a naturally occurring higher requirement for taurine or a metabolic abnormality that affects their taurine synthesis or utilization.

A second factor that affects taurine status in dogs is size. There is evidence that a large adult size and a relatively slow metabolic rate influences the rate of taurine production in the body and may subsequently lead to a dietary taurine requirement. It is theorized that increased body size in dogs is associated with an enhanced risk for developing taurine deficiency and that this risk may be exacerbated by a breed-specific genetic predisposition.[7]

There is additional evidence that large and giant breed dogs have lower rates of taurine production compared with small dogs. Ultimately, studies suggest that certain dogs possess a genetic predisposition to taurine depletion and increased susceptibility to taurine-deficiency DCM and that this susceptibility may be related to the combined factors of breed, size, and metabolic rate.

THE ROLE OF DIET

The recent spate of cases and media attention to taurine-deficiency DCM in dogs suggests that this is a very new problem in dogs. However, it is not new. A connection between diet and DCM in dogs was first described in a paper published in the *Journal of the American Veterinary Medical Association* in 2001.[8] What *is* new is the sudden focus on certain pet food ingredients and the target that appears to have been placed upon the backs of all "grain-free" pet food brands by some bloggers and veterinarians.

Not to put too fine a point on this, but the 12 cases of taurine-deficiency DCM described in the 2001 paper were collected between 1997 and 2001, years before grain-free dog foods had arrived on the pet food scene. Rather than disparage one class or type of dog food (or pet food company), it is more important to look at specific dietary factors that may be involved in DCM in dogs.

Generally speaking, these are expected to be the same as those identified for cats, including low protein levels, poorly processed or heat-damaged proteins (leading to Maillard products), and the inclusion of a high proportion of plant-based protein sources such as peas and legumes.

Over the past 15 years, reduced taurine status in dogs has been associated with feeding lamb meal and rice diets, soybean-based diets, rice bran, beet pulp, and high fiber diets.[9,10,11] As with cats, there appear to be multiple dietary (and genetic) factors involved.

For example, it was theorized that the perceived (not proven) association between lamb meal and taurine status was due to low levels of available amino acids present in the lamb meal, or to excessive heat damage of the protein, or to the confounding factor of the inclusion of rice bran in many lamb meal-containing foods. To date, none of these factors have been conclusively proven or disproven. However, the most recent study showed that three types of fiber source – rice bran, cellulose, and beet pulp – all caused reduced plasma taurine levels in dogs when included in a marginally low protein diet, with beet pulp causing the most pronounced decrease.[11]

Complicated? You bet. This is why it is important to avoid making unsupported claims about certain foods and brands. Taurine-deficiency DCM has been around for a while in dogs and continues to need study before making definitive conclusions about one or more specific dietary causes.

CURRENT CONSIDERATIONS

We know that any dietary factor that reduces the availability of taurine precursors, binds taurine bile salts in the intestine, or causes an increase in the bacteria populations that degrade taurine can reduce a dog's ability to

synthesize taurine or will increase taurine degradation and/or loss in the feces. These changes could ultimately compromise a dog's taurine status (especially if the dog was genetically predisposed) and affect heart health. In extreme cases, as we are seeing, this can lead to taurine-deficiency DCM (see diagram on page 4).

The FDA report identified foods that contain high amounts of peas, lentils, legume seeds, or potatoes to be of potential concern. The FDA also stated that the underlying cause of DCM in the reported cases is not known and that at this time, the diet-DCM relationship is only correlative (not causative). However, this has not stopped various bloggers and even some veterinarians from targeting small pet food companies and/or grain-free brands of food, and implying that these foods, and these foods alone, are causing taurine-deficiency DCM in dogs. Their reasoning is that peas and legumes are present in high amounts in foods that are formulated and marketed as grain-free.

However, the truth is that many companies and brands of food include these ingredients. More importantly, there is no clear evidence showing that a particular dog food type, brand, or even ingredient is solely responsible for taurine-deficiency DCM in dogs.

Rather, it is more reasonable and responsible to speculate that one or more of these ingredients, their interactions, or the effects of ingredient quality, heat treatment, and food processing may play a role. Furthermore, the underlying cause could be the protein, starch, or fiber fractions of these ingredients. As plant-source proteins, peas and lentils and legumes include varying amounts of starch (both digestible and resistant forms) and dietary fiber. These protein sources are also generally less nutritionally complete and less digestible than are high quality animal source proteins – additional factors that could influence a dog's ability to both produce and use taurine. Potatoes, on the other hand, provide a digestible source of starch in an extruded food but also contain varying levels of resistant starch, which is not digested and behaves much like dietary fiber in the intestinal tract.

HEART OF THE MATTER

Because any or all of these dietary factors could be risk factors for taurine-deficiency DCM in dogs, and because peas, legumes, and other ingredients identified by the FDA report have not yet been fully studied, the heart of the matter is that *no* conclusions can *yet* be made about the underlying dietary cause or causes of taurine-deficiency DCM in dogs.

But given what we *do* know, we recommend feeding a diet that contains sufficient levels of high-quality, animal-source protein, does not include plant-source proteins as primary protein sources, and does not contain high levels of dietary fiber.

If you are worried about your dog's taurine status or heart health, whether due to his diet history or physical signs that are of concern, see your veterinarian for a complete physical examination and if needed, to measure plasma levels of taurine.

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