The Effects of Taurine Supplementation with a Grain-free Diet on Cardio Health in Canines

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Abstract

Dilated cardiomyopathy (DCM) is a type of heart disease which affects the muscle of the heart causing it to thin and resulting in the enlargement of the left ventricle. If DCM is left unresolved, it can result in congestive heart failure. In the past decade, cases of DCM in canines have increased dramatically. The growing popularity of grain-free canine diets has been suggested as a possible contributor to this increased prevalence of DCM. These diets typically contain very low levels of the amino acid taurine. Taurine is a sulfur amino acid that plays a role in the calcium pools within the cardiac cells that are responsible for proper contractions of the heart. Grain-free diets typically have a reduced amount of animal by-product which is the main source of taurine in conventional canine diets and are generally rich in legumes, such a lentils and peas, which are low in sulfur amino. Legumes also contain a high content of fermentable carbohydrates which leads to a gastrointestinal loss of taurine. Although some evidence links grain-free diets and taurine deficiency, results are contradictory and more research is needed to investigate the potential mechanism by which grain-free diets may contribute to DCM. Additionally, switching from a grain-free to a taurine-rich diet has the potential to reverse symptoms of DCM. Understanding the role diet and taurine may play in DCM in canines is important for maintaining the health of dogs in their roles as companions, therapy, and service animals.

Background

Grain-free diets

- Diets lacking grains such as rice, barley, wheat, corn, and oats.
- Legume substitutes such as peas, lentils, and quinoa are used.[1]
- High in protein, low in sulfur amino acids.
- Contain a reduced amount of animal by-product which is the main source of taurine in.
- Research suggests that these legume substitutes are causing taurine deficiencies.[1]

Taurine

- An amino acid that comes from diet but can be synthesized within the body by methionine and cysteine.[2]
- Regulate the calcium pools in cardiac cells for proper contraction, also an antioxidant and anti-inflammatory.
- Research found taurine deficiencies in cats causing cardiomyopathy, adding taurine to food caused cardiomyopathy to disappear almost completely.[4]
- Research has shown that supplementation of taurine is useful in the reversal of cardiomyopathy.[3,4,5,6]

Background Cont.

Dilated cardiomyopathy (DCM)

- Heart disease which affects the muscle of the heart causing it to thin and cause enlargement in the chambers of the heart.
- Thinning affects the ability to pump blood out properly, therefore it causes a backup within the chambers which causes the enlargement.[7]
- Clinical signs include decreased oxygen supply, possible collapsing, lethargy, coughing, extended abdomen, increased respiratory and heart rate, and weight loss.
- DCM can lead to congestive heart failure (CHF) if pressures in the heart are significantly high.

Congestive Heart Failure (CHF)

- CHF can either affect the left side of the heart, right, or both.
- Left side blood leaks through the mitral valve which goes back into the left atrium.[7]
  - This causes fluid to get into the lungs.
- Right side blood leaks through the tricuspid valve which is between the right ventricle and atrium and back into the right atrium causing congestion and a back up in the cardiovascular system.[7]

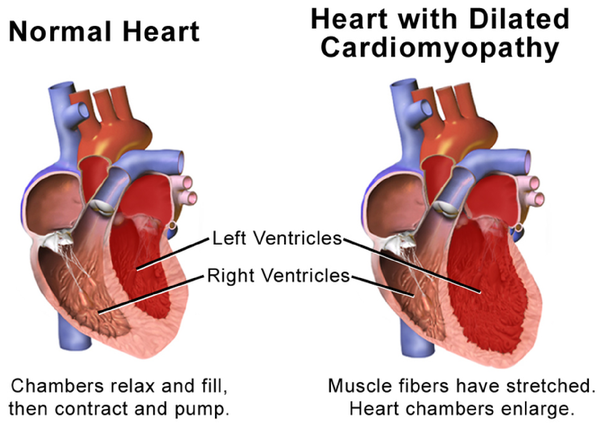

Figure 1: Diagram of normal heart vs. DCM

Hypothesis

If taurine supplementation is added to a grain-free diet, then it will reduce or prevent the likelihood of developing dilated cardiomyopathy.

Proposed Design

Control	Treatment 1	Treatment 2
Commercial diet, water gavage	Grain-free diet, water gavage	Grain-free diet, taurine supplementation

- Animal model is the Sprague Dawley rat
  - Weaned, aged 3 weeks old
- Study period of 3 months
- 5 rats per group
  - Randomly assigned
- Submitted for approval by Wilson College IACUC

Methods

Body Mass

- Weights of all rats will be measured weekly.

Heart Rate

- Using a stethoscope the heart rate will be determined weekly.
- Any abnormalities heard will be noted.

Blood Pressure

- Blood pressure will be taken and recorded weekly.
- Using a tail cuff fitted to the rat's tails.

Digital Radiography

- Radiographs of all rats taken on a monthly basis.
- Lateral position to best see the heart.
- Using a caliper, height and width of the heart will be measured to monitor any enlargement changes.

Blood Work

- Taurine levels monitored monthly collected via tail vein.
- Send to UC Davis laboratory.

Taurine Supplementation

- 1 g/kg orally once daily.
- Administered oral gavage.

Heart Morphology

- All rats will be euthanized to measure width of ventricles and weight.

Anticipated Results

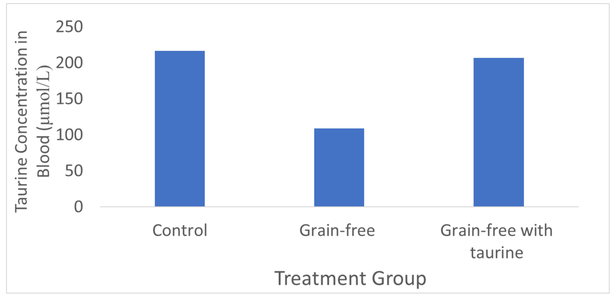

Figure 2: Comparing anticipated mean taurine concentration in whole blood for rats fed different diets at the end of the study.

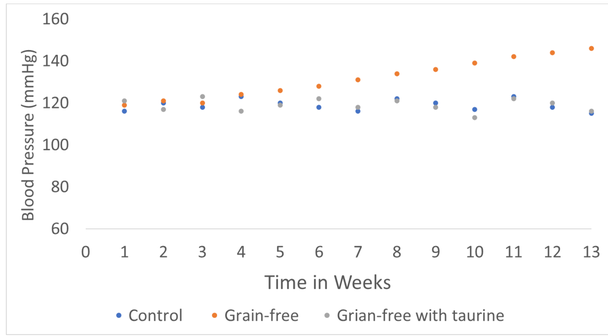

Figure 3: Comparing mean systolic blood pressure for rats being fed different diets.

Importance

- Understand the role diet and taurine play in DCM.
- Understand how certain ingredients can affect canines and formulate diets to better suit them.
- To maintain the health of canines in roles as companions and service animals.

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