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Metabolomics from a Diet Intervention in Atopic Dogs, a Model for Human Research?

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Introduction

Like humans, dogs too suffer from atopy and allergy. Anecdotal data suggest that a non-heated raw diet may help the disease. Strict diet intervention studies are easy to do on pet dogs as dog owners anyway tend to give their dogs the same food daily for months or years. Targeted metabolomics might shed light on common diet related physiology on a biochemical level.

Objectives

To investigate the altered metabolite levels and perturbed metabolic pathways after a dietary intervention in dogs suffering from atopy .

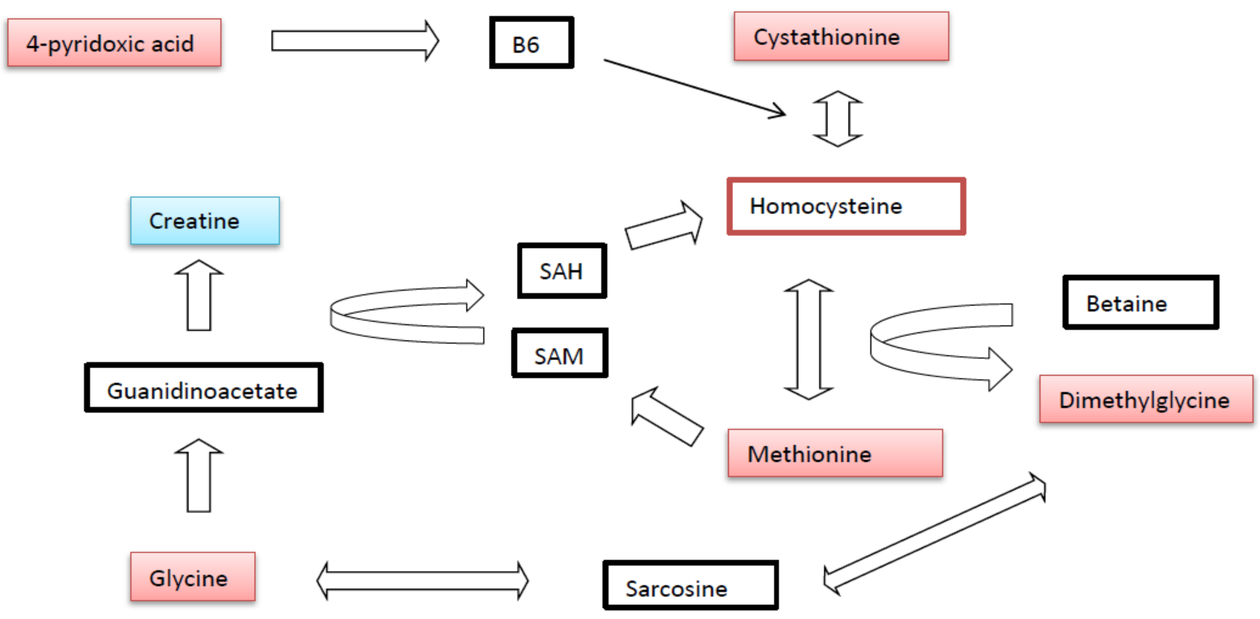
Material & Methods

A randomized controlled diet intervention that comprised either of a commercial high protein, fat and mineral raw food (n=13) or a more carbohydrate dense dry food (n=9) was carried out for 5 months. A high-throughput targeted semiquantitative metabolomics strategy was applied and 102 metabolites were measured at baseline and end of the study. The change from start to end (as %) was calculated for each metabolite as the diet group mean and compared between groups. For significance, Independent samples T-test was used with a $p<0.05$ (with Bonferroni $p<0.0005$).

Results

Among others, the following metabolites significantly increased in the raw food group while they decreased in the dry food group: Creatine ($p=0.007$), Cytidine ($p<0.0005$), Acetylcarnitine ($p= 0.004$), and Decanoylcarnitine ($p=0.019$). Among others, the following metabolites decreased in the raw food group while they increased in the dry food group: Glycine ($p<0.0005$), Dimethyl Glycine ($p=0.004$), Aminoisobutyric acid ($p=0.004$), Cytosine ($p<0.0005$), Proline ($p<0.0005$), Methionine ($p<0.0005$), Citrulline ($p<0.0005$), 4-Pyridoxic Acid ($p=0.005$), and Cystathionine ($p=0.001$).

Fig.1: Homocysteine metabolism and metabolites related to it. Metabolites in red boxes were up-regulated and metabolites in blue boxes were down-regulated in the dry food group.



Discussion

Methionine and cystathionine are part of the homocysteine metabolism and dimethyl glycine is the byproduct of that metabolism. Dimethyl glycine is also produced in the metabolism of glycine. 4-pyridoxic acid is a degradation product of vitamin B6, which in turn is a coenzyme in the cystathionine production. Cytosine is a pyrimidine base which takes part in the pyrimidine metabolism. 2-aminoisobutyric acid is an end product of pyrimidine metabolism. All these metabolites where increased in the dry food group, which means that homocysteine and pyrimidine metabolism where up-regulated in the dry food group. We actually saw that homocysteine increased ten times more in the dry food group than in the raw food group, but the difference was not statistically significant. Increased homocysteine level in blood has been reported to be associated e.g. with chronic kidney disease (1), Alzheimer's disease and vascular disorders (2) in humans.

Cytidine is composed of cytosine and sugar, and it can serve as a substrate for pyrimidine metabolism and is a protein component. It is high in organ meats and absorbed intact from the intestine. Acylcarnitines, like acetylcarnitine and decanoylcarnitine, are produced from fatty acids and carnitine. The raw food had higher fat content than dry food. Red meat is rich in carnitine and creatine. The high serum concentration of these metabolites in the raw food group might be due to the raw diet's high meat and fat content.

Conclusion

It is unclear if the diet compositions (protein versus carbo-hydrate) or the way of processing the food, i.e. if it was non-heated or heated, had an impact on the results. However, we propose that the dog should be further studied as a model for human research.

References:
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