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THE IMPACT OF DIET FAT ON CHOLESTEROL, TRIGLYCERIDE AND 3-OH-BUTYRATE CONCENTRATIONS IN BLOOD SAMPLES OF DOGS

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INTRODUCTION

Cholesterol is produced in the body through the liver and other body cells but also thought to increase by consuming animal-based foods such as poultry, dairy, and red meat. Their functions are: building hormones like estrogen and testosterone, maintaining the integrity of cell membranes, and aiding in the absorption of vitamins. **Triglycerides** are fatty acids that stores energy for later use and **Ketone bodies** can be produced as an energy source (see Fig. 1). Elevated levels of cholesterol and triglycerides in the blood have been associated with disease in man (Miller et al. 2011).

Research has shown that ketogenic diets that are high-fat (HF) - low carbohydrate (=carb) (LC) diets, compared to high-carbohydrate/carb (HC) diets, decrease triglycerides and increase ketone bodies in man (Brinkworth et al. 2009). We wanted to see if this also happen in the dog.

ANIMALS

A total of 44 client-owned Staffordshire bull terrier dogs were included in the analyses. Of these, 26 dogs were fed a commercial raw HF-LC diet (fat-carb = 50%-0% in dry matter) and 18 dogs a commercial kibble LF-HC diet (17%-48% in dry matter) during a diet intervention of a mean of 129 days. Mean age: 5.1 +/- 2.5 years.

Table 1. Analytical constituent of Hill's Science Plan™ Canine adult sensitive skin with chicken (Hill's 2016).

Analytical Constituent	In food	In dry matter
Protein (%)	25.3	27.5
Fat (%)	16	17.4
Carbohydrate (NFE) (%)	44.5	48.4
Fiber (crude) (%)	1.3	1.4
Moisture (%)	8	-
Calcium (%)	0.66	0.72
Phosphorus (%)	0.58	0.63
Calcium : Phosphorus	1.1 : 1	1.1 : 1
Sodium (%)	0.35	0.38
Potassium (%)	0.64	0.7
Magnesium (%)	0.07	0.08
Omega-3 fatty acids (%)	1.22	1.33
Omega-6 fatty acids (%)	4.76	5.17
Vitamin A (IU/kg)	9600	10435
Vitamin D (IU/kg)	480	522
Vitamin E (mg/kg)	600	652
Vitamin C (mg/kg)	70	76
Beta-carotene (mg/kg)	1.5	1.6

Table 2. Analytical constituent and ingredients of MUSH BARF Vaisto® pork-chicken-lamb diet (MUSH 2016a).

Analytical Constituent	In food	In dry matter
Protein (%)	15.2	38
Fat (%)	20	50
Ash (crude) (%)	4.20	10.5
Fiber (crude) (%)	0.60	1.5
Moisture (%)	60.0	0.0
Phosphorus (%)	0.65	1.6
Calcium (%)	1.09	2.7
Calcium : Phosphorus	1.7 : 1	1.7 : 1
Sodium (%)		*0.14–0.16*
Potassium (%)		*0.60–0.73*
Copper (%)		*0.0022–0.0026*
Iron (%)		*0.011–0.013*
Magnesium (%)		*0.05–0.06*
Zinc (%)		*0.011–0.013*
Vitamin A (IU/kg)		*12945–15664*
Vitamin D (IU/kg)		*63–76*
Vitamin E (IU/kg)		*4.69–5.68*

Ingredients: Finnish pork 46 % (meat, lung, cartilage, heart, liver), Finnish chicken 29 % (meat, bone, gizzard, skin, heart, cartilage, liver), Finnish lamb 20% (bone, meat, lung, cartilage, liver), vegetables 5 % (spinach, broccoli, lettuce, cold pressed sunflower oil), egg < 1 %.

Table 1: The LF-HC diet, Table 2: The HF-LC diet. Analytical constituents of the 2 diets.

METHODS

Triglycerides and 3-hydroxybutyrate were analysed from Li-hep plasma and cholesterol from serum, both kept frozen at -80° C after the diet intervention. Statistical analyses were performed using the Mann-Whitney U test. Significance was set at p<0.05.

RESULTS

There was no statistical difference in any of the measured concentrations values between the diet groups at baseline (all >0.05).

At the end of the diet intervention cholesterol (p<0.001) and triglycerides (p=0.011) were significantly lower whereas 3-hydroxybutyrate (p=0.021) was significantly higher when the dogs had been on a raw HF-LC diet, compared to those that had been on the LF-HC diet. The increase in 3-hydroxybutyrate in the HF-LC diet was from 0.07 to 0.10 mmol/l.

Indicating healthy liver function, also ALAT (p=0.015) and AFOS (p<0.001) were significantly lower after the HF-LC diet.

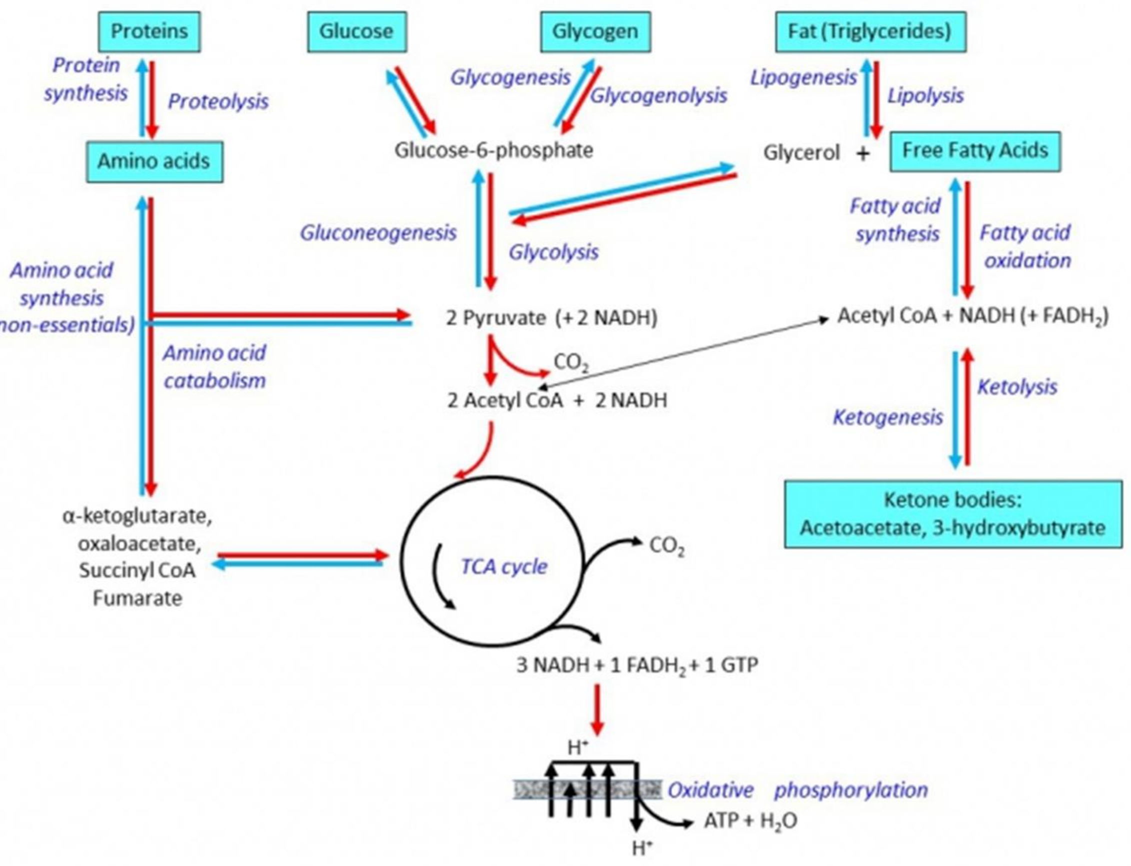

Fig 1: Energy metabolism uses carbohydrate glucose or proteins, or then ketone bodies as fuel.
(www.google.fi/search?q=glucose+ketone+metabolism+picture)

The HF-LC diet we used had 69.2% of the calories (ME DM) from the fat and the rest (38.8%) from proteins.

DISCUSSION

To our knowledge the only semi-ketogenic diet intervention that have previously been reported, were dogs treated with a medium-chain fatty acid diet for idiopathic epilepsy (Law et al. 2015, Packer et al. 2016). They also reported a statistically higher concentration of 3-hydroxybutyrate in the semi-ketogenic group compared to the "normal" diet, but having a lower mean that we had (~0.07 mmol/l) in their semi-ketogenic group.

Human ketogenic diets often have an even higher % of the calories coming from the fat than we had in our trial, often 70-85%, so we suspect that our dogs only started getting into a metabolic ketosis. One should remember that the fatal ketoacidosis starts only after 10 mmol/l so here we are talking about very "safe" ketosis.

The Ketopet sanctuary in the USA (ketopetsanctuary.com) work with canine ketogenic diets being served as a treatment for different types of cancers and we follow their results closely. With higher fat content their dogs also end up with higher 3-hydroxybutyrate (personal communication).

In man we measure the lipoproteins that carry cholesterols ("bad" LDL, VLDL, "good" HDL) to evaluate health. This has not yet been done in the dogs of this trial. With those results available, we will be able to see if we could use the dog as a valid model for ketogenic diet interventions in humans.

CONCLUSION

This study shows significant effect of the diet on fat metabolism parameters in dogs: After eating a high fat diet the dogs had significantly more ketone bodies and less triglycerides and cholesterol in their blood. This suggests that dogs also change from producing and using glucose to producing and using ketone bodies as fuel in their bodies.

Next we should analyse the change in the different cholesterol lipoprotein transporters (LDL, VLDL and HDL) in the trial dogs.

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