Beta-1,3/1,6-glucans promote well-being of obese dogs

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Obesity can be considered as one of the most common nutritional disorders in dogs and cats. Caloric restriction is often the solution to lose excessive weight, however success is difficult as the four-legged fellow, with friendly eyes, will beg for more food from his owner. Several clinical chronic health problems are correlated to being overweight. The adipocytes, cells specialized in fat storage, are metabolically active and responsible for inflammatory mediators, resistin and leptin. One of the complications of being overweight is insulin resistance, the low sensitivity of body cells to respond to insulin for the uptake of glucose as an energy source.

This article discusses the positive effects of a highly purified beta-1,3/1,6-glucan source in obese dogs with insulin resistance. In the boxes additional information is provided about differences between cereal and yeast beta-glucans, and the beneficial effects of yeast beta-1,3/1,6-glucans in other animal species with disorders related to the glucose metabolism.

Measuring efficacy of beta-1,3/1,6-glucans in obese dogs with insulin resistance

At the University of Sao Paulo, Brazil, the effect of yeast beta-1,3/1,6-glucans was investigated in privately owned obese dogs with clinically proven insulin resistance (1). Different parameters related to glucose and lipid homeostasis, inflammatory markers and satiety were evaluated and compared to healthy lean dogs. Figure 1 shows the design of the dog study. In the acclimation period of 15 days (Period 1), 7 obese dogs (body condition score 9/9) and 7 lean dogs (body condition score 5/9) received the same maintenance diet (control diet). The daily amount of food was calculated for each individual dog to maintain body weight. Over the next 90 days (Period 2), the trial continued with only the obese dogs. In this period, the obese dogs received the same control diet, with the addition of 0.1% MacroGard® (Biorigin, Brazil), a highly purified yeast beta-1,3/1,6-glucan source. Basal blood samples were taken for evaluation after the 15 days acclimation period and at the end of the 90 days of beta-1,3/1,6-glucan supplementation. At both timepoints an intravenous glucose tolerance test (IGTT) was also performed.

Glucose and lipid homeostasis

Being overweight increases the risk for metabolic disorders such as insulin resistance. Insulin resistance is characterized by high glucose and insulin levels in the blood. Body cells become less sensitive for insulin and thereby, inefficient to take up glucose from the blood and to use this glucose as an energy source. In the described dog trial, obese dogs receiving beta-1,3/1,6-glucans for 90 days showed important changes in metabolic parameters related to insulin resistance. Inclusion of 0.1% MacroGard® in the diet significantly reduced basal glucose, basal insulin, cholesterol and triglycerides concentrations in the blood of the obese dogs compared to the initial values (Figure 2). Where basal insulin shows an intermediate value, the other values were reduced to such an extent, that the levels were even similar to those of lean dogs. After the intravenous glucose addition in the IGTT, the blood glucose and insulin levels were still high, however, both the glucose and insulin peak tended to be lower after the supplementation of beta-1,3/1,6-glucans to the obese dogs.

Reduction of glycaemic values (glucose and insulin), cholesterol and triglycerides are in line with the results found in laboratory

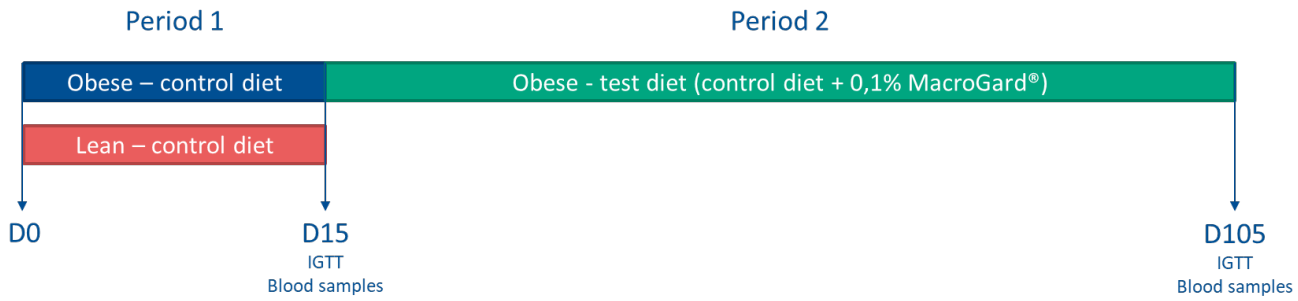

Figure 1: Timeline of the study measuring the effect of beta-1,3/1,6-glucans in obese dogs with insulin resistance, and comparing results with lean individuals.

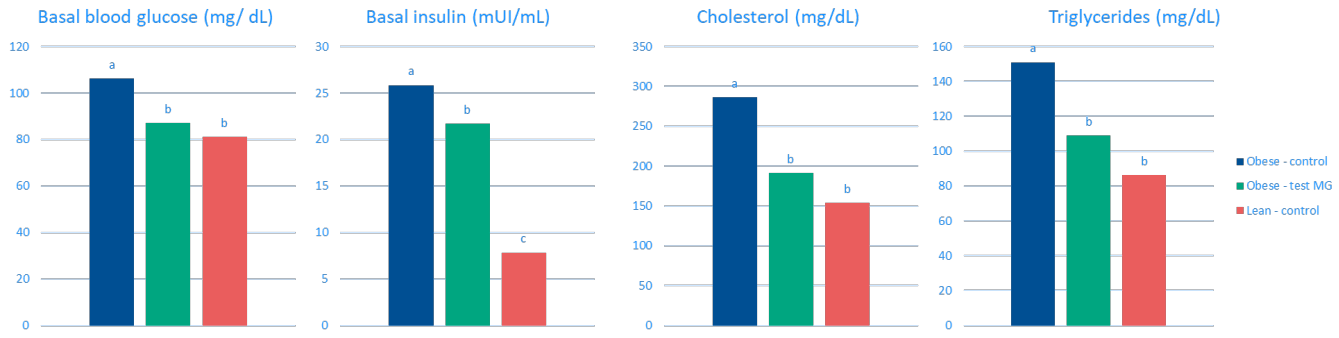

Figure 2: Effect of beta-1,3/1,6-glucans supplementation on metabolic parameters in obese dogs with insulin resistance, compared to values in lean dogs (P<0.05).

animals (2) (3) (Read box 'Glucose and cholesterol control by beta-1,3/1,6-glucans in other species'). Interestingly, in healthy animals with a normal glucose homeostasis, beta-1,3/1,6-glucans do not have any influence on these metabolic parameters (3) (4). However, when animals show hyperglycaemia, beta-1,3/1,6-glucans are able to reduce glycaemic values, even to the reference range of healthy individuals (1) (4).

Inflammatory status

Adipose tissue, possibly in combination with obesity associated comorbidities, are responsible for the production of many inflammatory mediators and adipocytokines. As a consequence, obese individuals often have a low-grade chronic inflammatory status. Weight loss is an effective solution to reduce the secretion of the inflammatory cytokines.

Even without performing a weight loss program in the dog trial, 90 days supplementation with MacroGard® resulted in lower serum TNF-α concentrations in the obese dogs, an important pro-inflammatory cytokine. Although not significant, other inflammatory markers IL-6 and C-reactive protein were also lower in the obese dogs after supplementation and became closer to the reference values found in lean dogs. Controlling the effects of low grade inflammation is noticed in other studies with MacroGard® as well, including trials on periodontitis (3) (5), osteoarthritis (6) and atopic dermatitis (7).

Satiety

Weight loss is the recommended treatment for obese animals. However, caloric restriction of pets is difficult, as it consequently leads to the animal seeking and begging for food and this behaviour may often compromise the owner and their compliance for restricted feeding. Dietary strategies to stimulate satiety without additional calories are of great interest for managing weight reduction of companion animals.

The release of appetite-regulating hormones plays an important role in controlling the caloric intake by pet animals. Both PYY and GLP-1 prolong the gastric emptying time and the small intestine transit time, and are known to reduce appetite and promote satiety.

In the obese dogs from the trial, MacroGard® seemed to increase the release of PYY. Despite the large numerical difference between the mean PYY value before and after supplementation in the overweighted dogs, the observed difference was not significant.

Glucose and cholesterol control by beta-1,3/1,6-glucans in other species

Not only is a large part of the pet population overweight, obesity and diabetes are also a main public health issue in humans and many research projects with laboratory animals as human models are focussing on nutritional solutions. A Brazilian research group of the Federal University of Lavras evaluated the use of highly purified beta-1,3/1,6-glucans from yeast (MacroGard®) in different settings and occasions of obesity and diabetes. In type 2 diabetic rats receiving a high fat diet, the effects of exercise and beta-1,3/1,6-glucans consumption were investigated. Independent of the physical exercise, ingestion of beta-1,3/1,6-glucans significantly optimized glycaemic parameters like lower fasting blood glucose and HbA1c levels. The beta-1,3/1,6-glucans also reduced predisposition to atherosclerosis, by significantly lowering levels of triacylglycerols, total cholesterol and LDL-C in the blood, while increasing HDL-C (also known as the 'good' cholesterol), resulting in an improved atherogenic index (2).

Completely in line with these results, in another rat study, consumption of highly purified beta-1,3/1,6-glucans (MacroGard®) lowered blood glucose, total cholesterol and triacylglycerols in diabetic animals with and without periodontal disease (3). Furthermore, in this study treatment with this beta-1,3/1,6-glucan source reduced the release of degradative enzymes and inflammatory markers (e.g. COX-2, NF-kB). Independent of the diabetic status, alveolar bone loss was reduced in animals with gingivitis that received beta-1,3/1,6-glucans. Attenuated alveolar bone loss is also demonstrated in other studies with beta-1,3/1,6-glucans in Wistar rats (8) and cats (5). All these promising results promote further research into the effects of beta-1,3/1,6-glucans in pet animals with excess of body weight or other comorbidities.

However, appetite regulating hormone GLP-1 increased significantly in obese dogs after receiving beta-1,3/1,6-glucans in their diet. The increase of satiety hormones could correlate to the practical observations in this study, where four out of the seven obese dogs were eating more slowly, presented food leftovers as the study progressed and why none of the dogs showed begging behaviour attempting to obtain more food.

Conclusion

Beta-1,3/1,6-glucans have proven to be beneficial for overweight dogs. Inclusion of 0.1% of highly purified beta-1,3/1,6-glucans from yeast in the diet can improve glucose and lipid homeostasis, inflammatory status and satiety in obese dogs with insulin resistance. These results are in line with studies in other animal species. Although the mechanisms require further investigations, cereal and yeast beta-glucans could be complimentary to each other in a weight control diet, as the carbohydrate structures have different physiological properties in the digestive tract. MacroGard® is a natural ingredient that has proven to be beneficial for weight loss programs and in diets for obese pet animals.

References are available on request

Cereal or yeast beta-glucans?

For centuries, cereal and fungal beta-glucans have been used for medicinal and cosmetic purposes. Beta-glucans are natural components of the cell walls of plants, some bacteria and yeasts. Glucans are polymers that contain glucose as the only building block. The specific way of how glucose molecules are connected to each other, influences the physiological properties of each specific glucan structure. Figure 3 shows a glucose molecule, and the numbers refer to the location where one glucose molecule can be linked to the next glucose molecule.

Beta-glucans found in plants and cereals are predominantly linear and have branches with ß-1,3/1,4-type linkages. These ß-1,3/1,4-type glucans are soluble with low molecular weight. In contrast, beta-glucans from yeast and fungi are insoluble, and have a linear ß(1,3) backbone with side ß(1,6) branches (Figure 3).

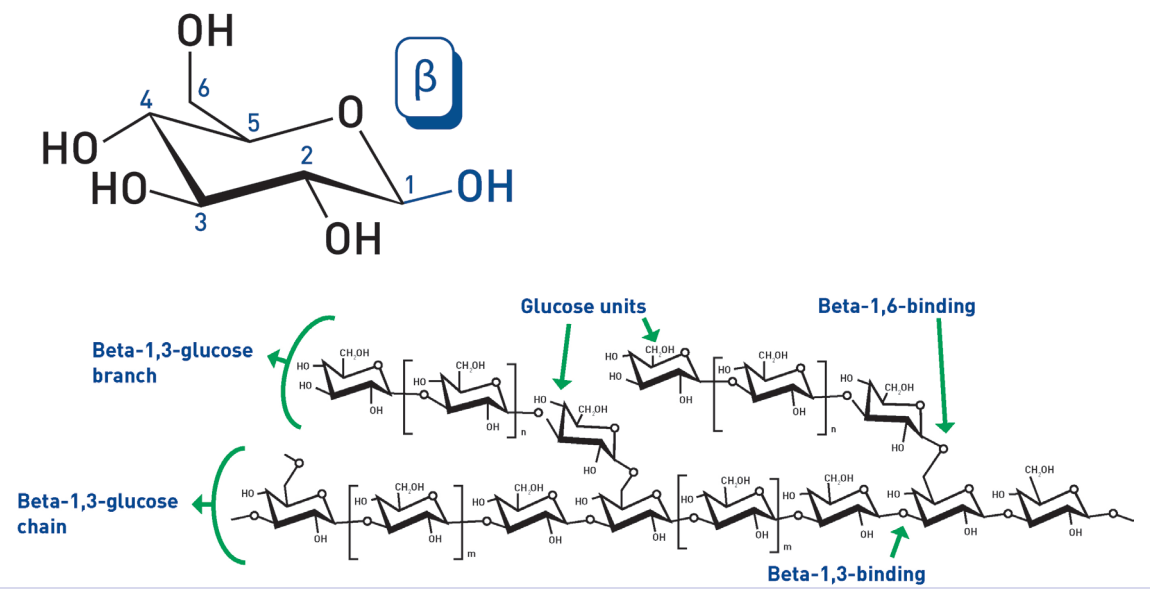

Figure 3: Glucose molecule showing the notation of carbon numbering for a binding place to the next glucose molecule. Below the typical beta-1,3/1,6-glucan structure from yeast derived beta-glucans is shown.

Oat beta-glucans are water-soluble fibre and well known for their property to lower blood glucose and cholesterol. The positive effects on these parameters are probably related to the physicochemical interactions between the oat beta-glucans and the digestive bolus in the intestinal tract. These water-soluble fibres increase the viscosity of the digesta, which delays gastric emptying and forms a gelatinous layer in the small intestine which reduces the uptake of nutrients like glucose. Further on in the digestive tract, oat glucans can also act as a prebiotic, where they are fermented and function as a growth substrate for beneficial bacteria.

Beta-1,3/1,6-glucans from yeasts are known for their immune modulating properties and are also actively investigated for their beneficial effects on human and animal health. Recently more research is performed on health problems related to obesity, insulin resistance and associated complications. Excess of adipose tissue and inadequate control of blood glucose levels are well-known factors that initiate or maintain a low-grade inflammatory status in the body. This explains why overweight or diabetic individuals often have other complementary health issues (e.g. gingivitis, osteoarthritis). Knowing the immune modulating capacities of yeast derived beta-1,3/1,6-glucans, makes these natural food components attractive for further research on obesity and related complications.