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Adding digestive enzymes to dog foods

An enzyme is a specific protein that facilitates the conversion of compatible substances as in digestion. The marketplace offers powdered digestive enzymes that can be sprinkled on dog food. There are very few commercial dry foods with added enzymes. Heating during pet food processing usually destroys the catalytic activity of enzymes, so surface application is necessary for finished kibbles. Normally, the objective of enzyme supplementation is helping digestion. The enzymes used may provide functions either common or uncommon to dogs.

The names of enzymes refer to the compound they act on followed by the suffix "ase". For instance, amylase digests amylose starch. Supplemental enzymes may be derived from bacteria, fungi or slaughtered animals' pancreatic tissue. As a rough estimate, 50 percent of ingested enzymes are destroyed by gastric acid and the dog's own proteases before reaching the small intestine.

Enzyme supplementation is the mainstay of treatment for dogs with exocrine pancreatic insufficiency. The degenerated pancreas produces inadequate amounts of proteases, lipase and amylase for digesting dietary proteins, fats and carbohydrates. Affected dogs excrete large amounts of stools at increased frequency, lose weight and are constantly hungry. Many patients benefit from dishing up commercial food mixed with bovine or porcine pancreatic extracts.

The available research data do not support efficacy and practical use of adding digestive enzymes to the diet of healthy dogs. This phrase not only concerns supplemental amylase and protease, but also foreign enzymes intended to deactivate dietary components (soluble non-starch polysaccharides) interfering with digestion.

Digestion of Macronutrients

When an enzyme is saturated by substrate supply, product formation is accelerated by increasing the amount of enzyme. Ingested enzymes that hydrolyse proteins, fats and carbohydrates can only stimulate digestion when the dog's own hydrolytic capacity is saturated. Digestion of macronutrients is determined by more than just enzymatic hydrolysis. Apparent digestibility of a nutrient is defined as the proportion which is not excreted in the faeces and thus assumed to be taken up by the body. At maximum digestibility, supplemental enzymes are ineffective.

Apparent starch digestibility in healthy dogs fed regular extruded foods generally is almost 100 percent. Thus, ingestion of amylase cannot increase starch digestion. This is illustrated by studies using diets containing poultry meal and grains. The kibbles were either furnished with an amylase-containing coating (1, 2) or they enclosed a heat-stable amylase added prior to extrusion (3).

Healthy dogs have been given protease, albeit not as the sole supplemental enzyme. Protease was put down on kibbles comprising poultry meal and grains with either 20 or 40 percent full-fat rice bran (4) or 30 percent soybean meal (5). The overall outcome was an apparent protein digestibility of 82.5 percent without and 82.8 percent with exogenous protease. The difference is meaningless, possibly due to low enzyme dosage. There are no published data on oral administration of lipase in healthy dogs.

Soluble non-starch polysaccharides

High intakes of indigestible, soluble non-starch polysaccharides raise the viscosity of small intestinal content, thereby impairing diffusion of digestive enzymes and mixing of digesta. As a result, macronutrient digestion is reduced. The non-digested material and polysaccharides are assimilated by the intestinal microbes. Bacterial fermentation products accumulate, causing the digesta to take in water by osmosis. Ultimately, lowered apparent macronutrient digestibility is accompanied by more stools with higher water content. Enzymatic hydrolysis of soluble non-starch polysaccharides offsets their ability to elevate digesta viscosity in the small intestine.

Replacement of dietary rice by sorghum or corn, which is associated with some extra soluble beta-glucans and/or arabinoxylans, slightly reduced protein and fat digestibility in healthy dogs (1). Spraying of enzymes, including xylanase and beta-glucanase, onto the extruded foods did not restore digestibility (1). Incorporating 25 percent wheat bran into the diet, largely at the expense of corn, lowered protein and fat digestibility (2). The diet change involves an increase in soluble arabinoxylans, but coating the kibbles with an enzyme mixture including xylanase did not correct protein and fat digestion (2).

Substituting high amounts of barley for wheat in the diet of healthy dogs led to more moist faeces (6). The ingredient exchange lowers the content of soluble arabinoxylans and elevates that of beta-glucans, but faeces quality deterioration was only partly reversed by attaching beta-glucanase to the kibbles (6). The study's message is that dog food should contain less than 30 percent barley.

Soybean meal contains rapidly fermentable galacto-oligosaccharides (raffinose and stachyose), mannan-oligosaccharides and soluble pectins. Foods containing 15 or 30 percent soybean meal, mainly with the loss

of poultry meal, raised faecal volume and water content. Topping up the kibbles with enzymes, including alpha-galactosidase, beta-mannanase and/or pectinase, did not negate the undesired impact of soybean meal on faeces characteristics (5, 7-9). Alpha-galactosidase added to a vegetable diet containing 22 percent soybean meal increased protein digestibility by 1.7 percent units (10).

Cellulose, fructo-oligosaccharides and phytate

In the canine gut, the insoluble cellulose is indigestible and non-fermentable. Investigators have affixed cellulase-containing enzyme mixtures to the surface of kibbles, but the apparent digestibility of cellulose, insoluble fibre or crude fibre was not measured (2, 5). Very high intakes of fructo-oligosaccharides induced somewhat wetter and looser stools, which was partly nullified by innulase (11). Phytase enhanced phosphorus absorption in one experiment (10), but not in another (4).

List of references is available on request from the author (beynen@freeler.nl)

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