Importance and selection of fibre in companion animal diets

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Nicola Ackerman BSc (Hons), RVN, CertSAN, CertVN ECC, A1, V1 explains the benefits of fibre in cats and dogs, gastrointestinal disorders it can help, as well as choosing the appropriate type

FIBRE plays an important role in the gastrointestinal system, acting as a prebiotic and to influence absorption and motility rates. Manipulation of the fibre type and content within the diet can be utilised in the treatment and/or management of gastrointestinal disorders.

Numerous gastrointestinal disorders can be encountered, and with each individual animal reacting differently to various diets (and the different fibre types and content), it is important to obtain a full nutritional and diet history from owners about their pets. Other factors such as stress, water consumption, activity levels and genetics all play a part in many gastrointestinal disorders. Therefore, a full detailed history incorporating these factors is required.

What is fibre?

Fibre refers to a range of compounds classed as complex carbohydrates that are resistant to the action of digestive enzymes **(**Table 1**).** The primary function and benefit of adequate dietary fibre is to increase bulk and water in the intestinal contents, but it also helps to promote and regulate normal bowel function and transit times.

Fibres include cellulose, hemicellulose, pectin gums and resistant starches. Fibre is classified by its chemical structure, but also by the rate of fermentation by intestinal bacteria, digestibility and indigestible fractions, solubility in water, waterholding capacity and viscosity (Table 2**;** Gross et al, 2000).

Fibres that are rapidly fermented by the gastrointestinal bacteria (for example, pectins), produce more short-chain fatty acids (SCFAs) and gases in a shorter period of time compared to more slowly fermented fibre sources. This can lead to borborygmus and flatulence. Pectins are commonly found in apples and citrus fruit.

The most common fibre sources in pet foods contain a mixture of pectins, hemicellulose and cellulose and this mix is classed as moderately fermentable. Types of these fibre mixtures include rice bran, oat bran, wheat bran, soy fibres, soy hulls and beet pulp. As the fermentation rate of the fibre used in the diet decreases, this will have the effect of increasing gastrointestinal transit time, and also increasing the faecal bulk. This can help to increase satiety in the animal, and is often included in weight loss diets.

Slowly fermentable fibres (for example, cellulose) are really effective stool bulking agents as they retain their structure for longer and therefore are able to bind water into the stool. This increase in faecal bulk and volume is advantageous for treatment and prevention of irritable bowel syndrome and constipation.

The important end products of fibre fermentation are the SCFAs, including acetic, butyric and propionic acids. They are the preferred energy source of the coloncytes, which derive more than 70 per cent of their energy requirements from the luminally derived SCFAs (Bergman, 1990). There is a rapid turnover of the epithelial cells within the gastrointestinal tract and, therefore, high energy needs.

Dogs fed diets containing fermentable fibres have an increased colon weight, mucosal surface area and mucosal hypertrophy when compared to dogs fed diets containing non-fermentable fibres (Hallman et al, 1995). These changes indicate an increased absorptive potential, which benefits the animal because it aids in prevention of diarrhoea by enhancing absorption of sodium. This, in turn, maintains normal intestinal electrolyte and fluid balance.

Other beneficial effects of the production of SCFA include promoting the growth of indigenous microflora and inhibiting the proliferation of pathogenic microbes (Kerley and Sunvold, 1997), acting as a prebiotic. Hence, if probiotics are being administered to an animal, prebiotics are also required to promote their proliferation within the gastrointestinal system.

Constipation

Constipation is a clinical sign characterised by infrequent, difficult or absence of defaecation, associated with retention of faeces within the colon and rectum (Buffington et al, 2004). There are numerous causes of constipation. It can be drug-induced or due to inadequate water consumption or limited activity levels. Pain can also lead to a pet’s reluctance to defaecate.

Maintenance of normal hydration is vital, so use of a wet formulation diet, or even adding water to

the wet diet, can help. In all constipation cases, resolution of the presenting episode needs to occur prior to the initiation of dietary changes. Increasing the fibre content of the diet with slowly fermentable fibres is indicated, as the animal needs an increase in gastrointestinal transit time and in stool volume.

Dietary transitions to these diets should be performed gradually by increasing the fibre content in increments. If side effects such as abdominal cramping or flatulence occur, it is recommended the fibre content is decreased by five per cent dry matter base (DMB) and the animal is reassessed (Ackerman, 2012). Titration of the dietary fibre content of the diet can be achieved by the use of food combinations with diets of varying crude fibre content.

Cats will occasionally suffer from chronic recurrent constipation, and this may lead to the colon becoming severely and irreversibly dilated and flaccid, a condition known as megacolon. The cause of megacolon is not known, but it can be linked to factors such as inadequate fibre intake, ingestion of excessive hair, environmental and psychologic factors such as painful defaecation or obstruction of the colon or anorectum, neuromuscular diseases, dehydration, hypokalaemia and drugrelated constipation (Buffington et al, 2004).

Recommendations need to be made to the owner about diet, water intake, activity levels and environmental enrichment. In situations of severe constipation or megacolon, where colonic motility is not present, the use of a high-fibre diet is not recommended. A highly digestible diet (dry matter digestibility of more than 90 per cent) is the diet of choice. Colonic motility modifiers such as cisapride can be useful, although treatment should be considered case specific, and can be dependent on the initiating cause (Ackerman, 2012). In early cases of megacolon, increased fibre content can be beneficial (Chandler, 2011).

Exocrine pancreatic insufficiency

In exocrine pancreatic insufficiency (EPI) cases it is important a highly digestible diet is used. It should be low in fat (lower or equal to 2g/100kcal) and fibre (less than two per cent DMB). The addition of exocrine pancreatic enzymes is required and diets high in fibre can impair enzyme activity.

Pancreatitis

Dietary long-term control of pancreatitis is vital, but initial confirmation of presence of hyperlipidaemia needs to be obtained. The presence (or not) of hyperlipidaemia will determine the best diet to utilise. If triglyceride levels are in normal parameters, a highly digestible, controlled fat level diet is indicated (approximately 14 per cent DMB). If hyperlipidaemia is present, fat levels need to be tightly controlled (approximately eight per cent DMB), but these types of diets can have a corresponding high-fibre content thus reducing digestibility (Ackerman, 2008).

Small intestinal bacterial overgrowth/antibiotic-responsive diarrhoea

Use of a fermentable fibre source is vital in cases of small intestinal bacterial overgrowth/antibiotic responsive diarrhoea to act as a prebiotic for the indigenous bacterial populations. To help prevent the overgrowth of the pathogenic bacteria, a healthy maintained and balanced microbiota is required. Bacteria exert this effect by their patterns of SCFA production and through direct inhibition of the growth of other microbial species.

Chronic idiopathic large bowel diarrhoea

Chronic idiopathic large bowel diarrhoea (CILBD) is presumed to be a stress-related disorder that may be concomitantly influenced by other factors, including inflammatory disease, dietary indiscretions, pathogen overgrowth, parasitic infection and neoplasia. Some sufferers of CILBD can be fibre responsive, with fibre aiding in promoting colonic health. Dietary management is recommended in all mild cases, although medical management may be required alongside dietary management in chronic or severe cases. Modifications to the diet include:

• high-fibre diets that normalise the transit time and bind faecal water (fibre also acts as a prebiotic aiding the strains and populations of gut bacteria).

• low-fibre, highly digestible diets that aid in reducing the quantity of undigested nutrients entering the colon.

• hypoallergenic diets, which can also be used when an intolerance or hypersensitivity is present.

When the initiating cause of the colitis is unknown, dietary modifications can be very much a case of trial and error, as the first two dietary modification options contradict each other (Ackerman, 2012).

Diabetes mellitus

High-fibre diets have been traditionally used for dogs suffering from diabetes mellitus. The increased fibre reduces the rate of absorption of simple sugars present in the diet, thus reducing the postprandial hyperglycaemia spike. The production of SCFAs also modifies the secretion of some of the digestive hormones and sensitivity of tissues to insulin. Complex carbohydrates should provide between 50 per cent and 60 per cent of the calories in diets for dogs (Michel, 2005). When feeding diabetic cats, a high-protein, low-carbohydrate diet has shown to enhance insulin sensitivity (Mazzaferro et al, 2003).

Renal disease

The type and content of fibre in diets designed for animals with renal disease can benefit its management. As already discussed, SCFAs are important energy sources for the intestinal cells and can increase blood flow to the intestine. Nitrogenous waste products in the blood are presented to the intestinal lumen where urease, an enzyme produced by intestinal bacteria, hydrolyses the urea into ammonia and carbon dioxide. The ammonia is then utilised by the intestinal bacteria. This process means nitrogenous waste products are excreted in faecal matter, rather than in urine by the kidneys (Ackerman, 2012).

Dietary fibre may also be beneficial for improving gastrointestinal motility in dogs with renal failure. Colonic transit times can be decreased in moderate renal disease as it alters duodenojejunal motility. The decrease of protein levels in renal diets results in a relative increase of the fat and carbohydrate levels. This results in an increase in calorific value and probable palatability due to the fat content. The increased fat content can also cause digestive upsets such as diarrhoea. If the dietary transition has been made over of a period of time, this is not a common side effect. If the diarrhoea persists, a combination of a higher fibre diet with low phosphate levels alongside the renal diet can be used. The balance will depend on the pet's response to the levels of fibre required.

Conclusion

Diets formulated to manage intestinal disease should ideally contain between three per cent and seven per cent, but no more than 10 per cent, fibre on a DMB (Sunvold and Reinhart, 1997). A balance of fermentable and non-fermentable fibre sources should be used in the diet to gain a balance of promotion of motility and supply of SCFAs, while maintaining digestibility and palatability of the diet for the animal.

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Above left and right: Peridale granules have excellent gelling qualities, and can absorb up to 60 times their volume in water. Below: Lactulose can be utilised to aid in relieving constipation.

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Lactulose 3.3g/5ml
Lactulose
500 ml
RESOL

Above left and right: Peridale granules have excellent gelling qualities, and can absorb up to 60 times their volume in water. Below: Lactulose can be utilised to aid in relieving constipation.

Complex carbohydrate type	Function	Digestion site	Digestion products
Starch, glycogen	Storage polysaccharide in plants and animals	Small intestine (enzymatic)	Monosaccharides and disaccharides (glucose, maltose)
Hemicellulose, cellulose	Structural parts of plant cell walls	Large intestine (microbial fermentation)	Volatile fatty acids (acetate, propionate, butyrate)
Lignins, cutins, waxes	Associated cell wall substances	Not digested or fermented	Excreted in faeces
Gums, pectins, mucilages	Naturally occurring polysaccharides in plants	Large intestine (microbial fermentation)	Carbon dioxide, methane, hydrogen, volatile fatty acids

TABLE 1. Classification and digestion of complex carbohydrates (Gross et al, 2000)

Carbohydrate and fibre fractions	Method	Fibre solubility	Total dietary fibre analysis	Crude fibre analysis
Fructans, galactans, mannans, mucilages	Rapidly fermentable	Soluble fibre	Total dietary fibre	
Pectin	Moderately fermentable			
Hemicellulose	Slowly fermentable	Insoluble fibre		
Cellulose				Crude fibre
Lignin	Not digested or fermented			
Resistant starch	Moderately fermentable			
Starch	Enzymatically digested			
Monosaccharides and disaccharides	Absorbed			

TABLE 2. Physiochemical and analytical properties of dietary fibre components (Gross et al, 2000)