RAW CONSULTANT

Nutritional training package

Natures Menu: Veterinary Division

4. Clinical Nutrition

The 5th Vital Assessment

Recently the World Small Animal Veterinary Association (WSAVA) named the often-neglected area of nutrition as the 5th vital assessment in veterinary practice. Following temperature, pulse, respiration and pain, nutrition plays a vital part in prevention, management and recovery from disease and surgery. A recent survey of clients revealed startling results when asked about nutritional recommendations made in practice. While 90% of pet owners want a recommendation only 15% perceive getting one. Clearly there is a large deficit here highlighting an area with huge potential to improve client relationships and their bond to a practice.

PET OWNERS WHO WANT A NUTRITIONAL RECOMMENDATION

90% of pet owners **want** a nutritional recommendation

PET OWNERS WHO PERCEIVE BEING GIVEN A NUTRITIONAL RECOMMENDATION

… but only 15% of pet owners perceive being **given** one.

Nutrition can play a vital role in the management of a vast array of clinical diseases. In this module we have discussed disease-specific recommendations, how raw feeding can be tailored to help meet these needs and the science behind the advice. While it is important to note that raw diets are not currently offered as prescriptive diets, this module merely acts to highlight the potential of raw nutrition within a variety of clinical settings.

Topics covered are as follows:

- Senior health
- Early development and growth
- Obesity
- Dietary sensitivities (allergy and intolerance)
- Gastric dilatation-volvulus
- Intestinal disease
- Pancreatic disease
- Hepatobiliary (liver) disease
- Chronic renal disease
- Endocrine disorders
- Cardiovascular disease
- Urinary disease
- Dermatoses
- Cancer cachexia
- Osteoarthritis
- Cognitive dysfunction
- Epilepsy

Senior animals

Definition of senior

Generally, companion animals are classed as senior when they enter the final third of their expected lifespan. Because of the huge variation between our pet cats and dogs, it is not clinically accurate to class every animal over eight years old as 'senior' for example a St Bernard at the age of seven could be classed as senior due to their average life expectancy of nine years of age. In contrast, a miniature Dachshund at eight years old would not be classed as senior due to their average lifespan of twelve years. When it comes to cats, many cats begin to demonstrate signs of ageing as early as eight years old but many will continue into their late teens and sometimes even early twenties. The aim of feeding senior animals is to slow or prevent the progression of metabolic changes associated with ageing however, care should be taken as many pets will have the additional complication of clinical disease associated with old age. Both older cats and dogs can suffer a number of age-related issues such as dental disease, loss of teeth, arthritis, obesity, inappetance and general lack of energy. All of these common problems may be eased or even prevented when fed a nutritional, balanced, species-appropriate diet.

Dogs

Dogs generally require 20% less energy than that of a younger dog of similar body weight when they are approaching old age. There is normally notable reductions in physical activity and lean body mass due to a lower basal metabolic rate. Some older dogs will have reduced digestive activity accompanied by a reduced appetite whereas others may start to become obese due to the natural energy levels decreasing. Importantly, nutrient requirements remain the same into the senior years and a reduction of food must not compromise on nutritional value. There is also no evidence that healthy older dogs require different levels of vitamins and minerals to that of young, healthy dogs.

Cats

As cats reach their senior years, their energy requirements also decline. Obesity however, is rare in older cats and they are usually found to be significantly underweight due to a decline in digestive function, especially of protein and fats which provide the younger cat with energy. Most cats can compensate well with an attentive owner and will self-increase their intake of food but increasing the food intake is not always the best option, as a more energy dense diet may be more appropriate. Cats require high levels of protein within their diets when leading a normal, healthy lifestyle but when entering into old age, some cats may suffer from digestive issues where protein metabolism is impaired. Restricting protein is not the answer as this will lead to many other problems so use a diet where the protein is of high quality, easily digestible and of high biological value. Hyperthyroidism is a

typical disease seen in senior cats and a ravenous appetite will occur with rapid weight loss (much to some owners confusion!) however, long periods of inappetance can occur in senior cats (especially those with dental disease) and hepatic lipidosis may prevail.

Early development and growth

Objectives when feeding a young animal are:

- ✓ Healthy growth
- ✓ Optimal trainability
- ✓ Good immune function
- ✓ Minimise obesity
- ✓ Prevent developmental orthopaedic disease

Growth rates of young dogs are affected by breed, nutrient density of food and the amount of food fed. Feeding for maximal rather than optimal growth increases the risk of skeletal deformities and obesity whilst decreasing longevity.

The requirements for all nutrients are increased during growth compared with adults. Most nutrients supplied in excess cause little to no harm, with some exceptions such as energy, which can lead to obesity, and calcium which can lead to skeletal abnormalities. During the first weeks after weaning, growing puppies use about 50% of their total energy intake for maintenance and the remainder for growth. The recommended minimum protein content in foods intended for growth is 25% on a dry matter basis (DM); there is no maximum as high levels have not been shown to be detrimental. Most commercial foods for puppy growth contain more protein than is needed. Protein for kittens is recommended to be much higher, at least 30% DM .

Dietary fat provides essential fatty acids (EFAs), a carrier for fat-soluble vitamins and a concentrated source of energy. EFAs are essential for neural, retinal and auditory development as well as being shown to improve trainability in puppies (Kelley, et al., 2004). No specific level for carbohydrates exists for growing puppies.

Obesity

An animal is classed as obese when the bodyweight is 15% or more than is recommended and it is the most common form of malnutrition within the UK. There are many animals who compensate well when they are obese but clinical issues can occur, some of which may not be noticeable to the average pet owner, such as;

- Osteoarthritis
- Respiratory disease
- Exercise intolerance
- Diabetes mellitus
- Circulatory problems
- Lowered immune response
- Liver disease
- Dermatological problems, especially in cats when self-grooming becomes an issue
- Feline lower urinary tract disease
- General anaesthetic and surgery risk

Obesity is the result of energy intake exceeding energy output and leads to the deposition of fat in adipose tissue throughout the body. Increase in fat cell size is referred to as hypertrophy while an increase in fat cell numbers is referred to as hyperplasia, which occurs in young growing animals. It is therefore vitally important that growing animals do not have an excess intake of energy if they are not expending it, as puppies and kittens who suffer from hyperplasia have a lifelong predisposition for excessive weight gain. The initial dynamic phase of fat deposition is followed by a static phase in which the animal remains fat but its bodyweight remains fairly stable.

A normal weight for an animal will depend on the breed, species and sex. Breed standards can be referred to for purebred dogs and cats, although this is not helpful for crossbreeds. A healthy sized average animal should not have clearly visible ribs but they should be easily palpable when placing your hands on the rib cage under a thin layer of fat i.e. you should not have to press your fingertips into the animal's side to be able to feel ribs. A waistline should also be visible just behind the ribcage where the body should 'nip-in' to form a normal, healthy body shape from above. Dogs tend to accumulate fat around their tail base and can sometimes develop a fat roll over this area which can lead to dermatological issues and/or anal gland problems. Cats tend to gain an 'apron' of fat around their groin area which can be seen swinging from side to side in some obese cases when the cat walks. Body condition scoring is a vital measurement for management of obesity in practice. The 9 score system recommended by the WSAVA (World Small Animal Veterinary Association) is shown in the tables below:

DOG

Score	Description	Feature			Estimated body fat %	% BW below/ above score 5
		Ribs & bony prominences	Abdomen	Tail base		
1	Emaciated	Visible from a distance and easily palpable with no overlaying fat	Severe abdominal tuck when viewed from the side, exaggerated hourglass shape when viewed from above	Prominent, raised bone structures with no tissue between the skin and bone. Obvious loss of muscle mass and no discernible body fat	< 4%	- > 40%
2	Very thin	Visible and easily palpable with no fat layer under the skin	Strong abdominal tuck when viewed from the side, accentuated hourglass shape when viewed from above	Prominent, raised bone structures with no tissue between the skin and bone. Minimal loss of muscle mass	4-10%	-30-40%
3	Thin	Discernible and easily palpable with minimal fat cover	Pronounced abdominal tuck when viewed from the side, marked hourglass shape when viewed from above	Raised bony structures with little tissue between skin and bone	5-15%	-20-30%
4	Slightly underweight	Easily palpable with minimal fat cover	Abdominal tuck when viewed from the side, slightly marked hourglass shape when viewed from above	Raised bony structures with little subcutaneous tissue	10-20%	-10-15%
5	Ideal	Ribs not visible but easily palpable with thin layer of fat. Other prominences are palpable with slight amount of overlying fat	Abdominal tuck when viewed from the side and well- proportioned lumbar waist when viewed from above	Smooth contour or some thickening, bony structures palpable under a thin layer of subcutaneous fat	15-25%	0%
6	Slightly overweight	Palpable with moderate fat cover	Less obvious abdominal tuck when viewed from the side, hourglass shape less pronounced when viewed from above	Smooth contour or some thickening, bony structures remain palpable under moderate layer of subcutaneous fat	20-30%	+10-15%
7	Overweight	Difficult to palpate ribs, thick fat cover	Little abdominal tuck when viewed from the side or waist and back slightly broadened when viewed from above	Smooth contour or some thickening, body structures remain palpable under subcutaneous fat	25-35%	+20-30%

8	Obese	Ribs difficult to palpate with thick layer of fat, other prominences are distended with extensive fat deposit	Ventral bulge under abdomen, no waist and back markedly broadened. Fat deposits over lumbar area and neck	Appears thickened, difficult to palpate bony structures	30-40%	+30-45%
9	Grossly obese	Ribs very difficult to palpate with thick layer of fat, other prominences distended with extensive fat deposit	Pendulous ventral bulge, no waist, back markedly broadened. Fat deposits over lumbar area, neck, face, limbs and in groin. A dip may form on the back when lumbar and thoracic fat bulges dorsally	Appears thickened, bony structures almost impossible to palpate	>40%	+ >45%

CAT

Score	Description	Feature		Estimated body fat %	% BW below/ above score 5
		Ribs & bony prominences	Abdomen		
1	Emaciated	Visible and easily palpable with no fat cover	Severe abdominal tuck when viewed from the side and an exaggerated hourglass shape when viewed from above	<10%	- >40%
2	Very thin	Visible on shorthaired cats, easy to palpate and no fat cover	Severe abdominal tuck when viewed from the side and a marked hourglass shape when viewed from above	5-15%	- 30-40%
3	Thin	Easily palpable with minimal fat cover	Marked abdominal tuck when viewed from the side and an obvious waist when viewed from above	10-20%	- 20-30%
4	Slightly underweight	Easily palpable with minimal fat cover	Abdominal tuck when viewed from the side and a well-proportioned waist when viewed from above	15-25%	- 10-15%
5	Ideal	Palpable with a slight fat cover	Abdominal tuck present when viewed from the side, well-proportioned waist when viewed from above	20-30%	0%
6	Slightly overweight	Palpable under moderate fat cover	Abdominal tuck and waist less pronounced. Mild abdominal fat pad may be palpable	25-35%	+ 10-15%
7	Overweight	Palpable under a moderate fat cover	No abdominal tuck but moderate abdominal fat pad is visible when viewed from side and no waist when viewed from above	30-40%	+ 20-30%

8	Obese	Difficult to palpate under a thick fat cover	Pendulous ventral bulge with some abdominal fat deposits when viewed from the side. Broadened back when viewed from above	35-45%	+ 30-40%
9	Grossly obese	Very difficult to palpate under a thick fat cover	Large pendulous ventral bulge with extensive abdominal fat deposits when viewed from the side. Markedly broadened back when viewed from above. Fat deposits around face, neck and limbs	>45%	+ >40%

Recent data from the Pet Food Manufacturers Association (PFMA) suggests that as many as one in three pets in the UK are obese. Mirroring the human obesity epidemic in the developed world, pets are not far behind. In multiple studies higher protein and lower carbohydrate diets have been shown to be more effective in pet weight loss. In one study, cats fed a higher-protein diet lost more body fat while reducing their loss of lean body mass by 50% (Laflamme, 2005). A further study confirmed that increased protein intake favours the maintenance of lean body mass during weight loss in obese cats (Vasconcellos, 2009). The results also suggest that protein may reduce the calorie restriction needed for weight loss. In addition, protein intake appears to act on a long-term basis, resulting in greater calorie requirements during the subsequent phase of weight maintenance. These aspects are important for successful weight loss and maintenance in cats and deserve further study.

A higher protein: carbohydrate ratio is also known to provide a more stable energy release resulting in less hyperactivity and a more stable blood glucose level. Reduced hyperactivity can also be attributed to foods with less additives, artificial colours and flavours, which are generally not present in raw food diets due to their natural ingredient base.

Care needs to be taken when encouraging weight loss as at a rapid speed, this can lead to severe metabolic problems. Slow weight loss towards an achievable target should be aimed for by feeding for the desired weight, rather than the current weight to help achieve some loss. The amount of food should be decreased gradually to help prevent animals feeling overly hungry. For example, if a dog weighs 30kg and should ideally weigh 20kg, we would advise first feeding for a 28kg dog. Once achieved, then decrease to a 26kg daily amount until achieved and continue to decrease every few weeks until the weight is deemed healthy. Increase in exercise is also key but care should be taken when dealing with excessively overweight animals due to compromised respiratory and heart function. Dogs can be increasingly walked and are easily given extra energy releasing activities such as feeding from a toy or by scattering the food to prevent gobbling. Cats can be more difficult to increase energy expenditure but ‘chase-it toys’ are always popular and can be combined with running up and down stairs. A diet with a reduced calorie level should be fed to animals wishing to lose weight as reducing a normal, balanced diet can lead to nutritional compromise due to components or levels being removed

or decreased. L-carnitine (synthesized from the amino acids lysine and methionine) plays a vital role in fat metabolism and energy production, it is key to weight loss and aids in the retention of lean body mass.

Dietary sensitivity

Dietary sensitivity can be separated into two main clinical problems. **Food intolerance** is a clinically abnormal response to a dietary component which may occur from the impaired ability to digest the specific food type. This could be due to the lack of the digestive enzyme needed to break down this food type or could be a more in depth problem associated with pharmacological, metabolic or toxic reactions. The other clinical problem seen is a **food allergy or hypersensitivity** which is an immune-mediated phenomenon. Both food allergies and food intolerances are very difficult to distinguish due to their similarity in visible symptoms and the medical approach to both is the same.

Symptoms may include:

- pruritus (skin irritation) which can lead to self-trauma
- otitis externa
- miliary dermatitis
- eosinophilic plaque in cats (raised, ulcerated lesions, often found on the abdomen)
- diarrhoea
- irritable bowel disease
- idiopathic chronic colitis
- many other uncomfortable problems may be seen within individual animals

The dietary sensitivity can be associated with any ingredient or even additive but most are caused by protein intolerance (Paterson, 1995). Firstly, the allergen must be identified and eliminated from the animal's diet. If the specific protein source is unidentifiable at this stage, then a diet should be fed containing a protein source which the animal has not been exposed to in the last month. The trial period for elimination diets is usually around sixty days. If symptoms subside within this time, other single source proteins can be gradually introduced to assess if a reaction is noticeable. This will then enable the owner to decipher which source the pet is intolerant to. A diet which does not contain the allergen is said to be 'hypoallergenic' for that particular individual.

Gastric dilatation-volvulus (GDV)

Gastric dilatation-volvulus (GDV) is characterised by rotation of the stomach on its mesenteric axis, entrapping gastric contents (food, fluid and air) and compromising vascular supply to the stomach, spleen and pancreas. Acute GDV is an emergency with high morbidity and mortality (Monnet, 2003; Buber, et al., 2007). GDV commonly affects large-breed, deep-chested dogs. Affected dogs commonly make repeated unproductive attempts to vomit with abdominal distension, pain and hypersalivation.

In the past feeding un-moistened cereal or soy-based dry foods have been incriminated as a risk factor for developing GDV but more recent epidemiological studies have shown this to be untrue (Raghavan, et al., 2004; Raghavan, et al., 2006).

Aerophagia is a significant source of gastric gas in dogs with GDV and increases with rapid food consumption, stress, exercise and excitement. Control of these factors where possible in high-risk dogs is recommended. Feeding at-risk dogs 2-3 times a day and alone can reduce competitive eating, along with specially designed food bowls intended to slow food consumption (Davenport, et al., 2010).

Highly digestible meat-based diets are known to encourage gastric emptying and reduce stomach distension (Lane & Cooper, 1999), which are also key factors in GDV. However, further work is needed to demonstrate their role in decreasing the incidence of this complex and multifactorial condition.

Intestinal disease

Diarrhoea

Diarrhoea can be associated with increased volume of stools, increased frequency but more importantly and notably the fluidity of the faeces. All these factors should be taken into account with the diet which is currently being fed to the animal in question for example, a diet high in fibre will lead to a marked increase in faecal volume compared to a diet fed of highly digestible components. Diarrhoea can be classed as chronic in cases where it has persisted for more than 3-4 weeks.

In normal digestion, large amounts of water are secreted and/or consumed into the gastrointestinal tract every day and approximately 95% of this water is reabsorbed by the body but a very small decrease in reabsorption can lead to diarrhoea. This can occur for a number of reasons;

- Osmotic diarrhoea occurs when there is an interference with nutrient absorption or digestion. The nutrients retained in the intestinal lumen can create an osmotic effect (retention of water) which leads to diarrhoea. It is most commonly seen with nutritional overload (too much

food) or can be associated where there is a deficiency of enzymes or enterocytes (intestinal absorptive cells) including exocrine pancreatic insufficiency (EPI – common in German Shepherd dogs), small intestinal disease or brush border enzyme deficiency (such as lactase).

- Secretory diarrhoea is caused by an increased secretion of fluid into the intestine by enterocytes and may be stimulated by bacterial toxins and by the products of bacterial degradation of bile acids and dietary fat.
- Mucosal damage to the lining of the intestinal tract which increases intestinal permeability. This may have resulted from inflammatory conditions. If the pore size in the lining is large, fluid and plasma proteins escape into the intestinal lumen and create protein-losing enteropathy and diarrhoea.
- Altered intestinal motility can result in stagnation of intestinal contents, bacterial proliferation and degradation of nutrients. Think of the intestine as a sock containing an orange. Squeezing the sock from one end to the other will eventually expel the orange and this is similar to the muscular motility movements within the intestine.

Small intestinal disease

Small intestinal disease results in the increase of faecal volume as the small intestine is the main site for digestion and nutrient absorption. Pale, fatty stools (known as steatorrhoea) are seen in cases of malabsorption or maldigestion of fat, exocrine pancreatic insufficiency being one of these diseases. Weight loss is very common, alongside an increased appetite, as the nutrients consumed by the animal are not fully digested or utilised so the body increases the uptake of food to try and address the low levels. Diet plays an important role with animals suffering from small intestinal disease and although not all animals are the same and will respond to the same dietary changes, a few general rules apply. Highly digestible diets are suggested as many small intestine diseases interfere with the digestive and absorptive function, making high fibre diets undesirable due to their natural inability to be digested. A restriction of dietary fats is recommended when fat absorption or digestion is disturbed in such cases as exocrine pancreatic insufficiency (EPI) where the pancreatic enzymes are reduced or completely absent, small intestinal bacterial overgrowth (SIBO) which effects bile salts and lymphangiectasia (dilation of the lymph vessels). The restriction of dietary fat is far less important in cats as they appear to do far better on moderate to high fat diets when suffering from small intestinal disease.

A number of dietary modifications can be made when dealing with animals suffering from a small intestinal disease:

- Moderate to high levels of good quality protein are recommended as protein deficiency can further compromise a diseased intestinal tract.

- Protein must be considered carefully due to most dietary intolerances/hypersensitivities being associated with them. Gluten, a protein in wheat and barley, is responsible for a particular enteropathy in Irish Red Setters in which poor weight gain along with weight loss and diarrhoea is associated. Where sensitivity occurs, protein sources should be limited to one or two.
- Carbohydrate digestion and absorption can be impaired with conditions that line the intestinal wall however, starch presents a much lower digestive challenge than that of fat and in these cases, carbohydrate maybe used as the primary energy source alongside restricted fat levels.
- Fibre should be avoided as in the short term, it may improve faecal consistency but could interfere long term with small intestinal diseases by interfering with absorption and digestion, and therefore compromising an already impaired gastrointestinal tract. In particular, soluble fibre is contraindicated in exocrine pancreatic insufficiency as this may interfere with enzyme activity.
- Water soluble vitamin B complex may become deficient in some small intestinal diseases, especially cobalamin (B_{12}) and folate so foods containing moderate to high levels of these should be sourced.

Large intestinal disease

Large intestinal disease is often associated with frequent defecation of diarrhoea with small quantities being passed each time. This may be due to urgency, straining or pain on defecation. Fresh blood and mucous are very characteristic of large intestinal disease whereas weight loss is rarely seen, however, this may occur as a secondary problem if appetite is decreased due to primary issues. Dietary fibre can be beneficial when treating animals with a disease associated with the large intestine and a mixture of both soluble and insoluble fibre is recommended for the following reasons;

- Soluble fibres create bacterial fermentation which in turn yield short chain fatty acids. These are essential for cell health within the large intestine.
- Insoluble fibres are non-fermentable and contribute to faecal bulk. This will help exercise the muscles within the colon and help produce a firmer stool consistency.

Many cases of colitis and inflammatory bowel disease are thought to be immune mediated and therefore, single source protein diets or 'hypoallergenic diets' are highly recommended in these cases.

Flatulence

Flatulence is excessive formation of gases in the stomach or intestine and can be a common reason pet owners seek veterinary advice. It is usually associated with the following three insults:

- Flatus – gas expelled through the anus
- Eructation – noisy voiding of gas from the stomach through the mouth

- Borborygmus – rumbling noise caused by the propulsion of gas through the intestines

While flatus, eructation and borborygmus occur in normal pets, they can often develop as a consequence of small intestinal or colonic disorders. Excessive aerophagia is a risk factor for flatulence and is seen with brachycephalic, working and sporting canine breeds and pets with aggressive and competitive eating behaviours.

Gas in the gastro-intestinal tract is normal and may arise from aerophagia, intraluminal gas production and diffusion of gas from the blood. Using highly digestible foods is key in the management of flatulence as it reduces the residues available for colonic bacterial fermentation, which is responsible for many of the malodorous gases expelled. Studies in dogs have shown that using rice as a carbohydrate source results in less intestinal gas formation than foods containing more complex, harder to digest carbohydrates, such as wheat or corn (Washabau RJ, et al., 1986). Leguminous protein sources such as soybean meal should be avoided in pets with excessive flatulence (Roudebush, et al., 2010). Protein sources with higher digestibility should be selected, such as those found in raw foods (Crissey, et al., 1999; Murray, et al., 1997). Soluble or fermentable fibre-enhanced foods may contribute to excessive flatulence in some patients, therefore the amount of fibre should probably be limited to no more than 5% DM (Roudebush, et al., 2010).

Carminatives are preparations to relieve flatulence and can be of medical, herbal or botanical origin. Two examples are yucca extract which is thought to decrease faecal aroma, and grape seed extract which alters gastrointestinal microbiome and decreases faecal release of volatile sulphur compounds.

Anal sac impaction

Disease of the anal sacs is a common reason for presentation of dogs to a veterinary surgeon. It is less common in the cat. Little is known of the aetiology or pathogenesis of anal sac disease so treatment is often symptomatic. Predisposing factors to anal sac disease are soft stools and obesity (Scarff, 2010).

If simple anal sac impaction is present, then increasing the dietary fibre may help in management (Scarff, 2010). This often firms up the stool and allows more natural emptying of the anal sac secretions during normal defecation. Obesity management is also key to prevent deposition of fat around the external anal sphincter interfering with normal anal sac expression.

Raw foods, including ground bone and raw meaty bones, are well known to produce much firmer stools and also aid in the process of simple anal gland impactions. As discussed under obesity, a high protein raw food can also offer a great way to manage weight loss and prevent further anal sac issues.

Pancreatic Disease

Pancreatitis

Pancreatitis can present as an acute or chronic disease process and commonly manifests with gastrointestinal symptoms such as vomiting and diarrhoea. An episode may follow a dietary indiscretion involving consumption of a high level of fat and has also been associated with the administration of some drugs, such as corticosteroids (Simpson, 1993).

Dietary fat levels are crucial in management. Obese or hypertriglyceridaemic patients should receive low fat foods (<10 and <15% DM for dogs and cats respectively), while other patients can be fed moderate-fat foods (<15% and < 25% DM for dogs and cats respectively). Patients must avoid both excesses and deficiencies of protein; amino acids in the duodenum are a strong stimulus for pancreatic secretion, while protein is also essential for recovery and tissue repair. Levels of 15-30% DM in dogs and 30-40% DM in cats are appropriate.

In cats with concurrent inflammatory bowel disease (IBD) or triaditis, assessment of cobalamin is recommended as dietary supplementation may be required. Antioxidants, such as selenium and vitamins C and E have been shown to reduce pain by as much as 50% in humans, although similar trials have not been performed in dogs and cats.

Exocrine Pancreatic Insufficiency (EPI)

Exocrine pancreatic insufficiency (EPI) refers to a partial or complete deficiency of pancreatic enzymes and is the most common cause of maldigestion in dogs (Williams, 1994). Occurring most commonly in young dogs as a congenital disorder (pancreatic acinar atrophy), EPI may also develop as a consequence of acute and chronic pancreatitis or pancreatic neoplasia. EPI is rare in cats but has been reported in both juvenile and acquired forms. Typically patients with EPI have chronic small intestinal diarrhoea, weight loss and failure to thrive. Faeces are often voluminous, greasy, foul smelling and pale in colour.

The primary nutritional factor in management of EPI is the use of foods with high digestibility (fat and carbohydrate >90% and protein >87%), coupled with the addition of pancreatic enzyme preparations. High fat foods (>27% DM) should be avoided as they can result in increased frequency of defecation and poor faecal consistency. Dietary fibre should be restricted, ideally less than 5% DM, to maximise food digestibility.

Absorption of the fat soluble vitamins (A, D, E, K) should be considered and supplemented only if patients have demonstrably low levels. Folate and cobalamin are also of concern and should be monitored and corrected as appropriate.

Hepatobiliary Disease

The liver has a huge number of key roles within the body and can prove very challenging to manage when it is affected by disease. In addition to its roles in drug metabolism, removal of environmental and endogenous noxious substances and synthesis of important substances (e.g. albumin and blood clotting factors), the liver plays a key role in food digestion and nutrient metabolism. The liver influences nutritional status through its production of bile salts and central role in intermediary metabolism of protein, carbohydrate, fat and vitamins. The liver has tremendous storage capacity, functional reserve and regenerative capabilities. However, these same characteristics complicate and can often delay the diagnosis of serious liver disease.

Due to the wide range of hepatobiliary diseases and their differing severity, one nutrient profile might not always be ideal for all patients. These recommendations support a common profile to benefit most liver disease patients but each should be assessed as an individual. Provision of adequate daily energy intake is key in many liver disease processes in order to allow protein synthesis and prevent tissue catabolism that generates ammonia.

Protein deficiency can play a role in feline hepatic lipidosis and dietary protein, along with the amino acids taurine and arginine, should be considered. 30-45% DM protein is usually well tolerated in these cats. In dogs there is a fine balance to be achieved with regard to dietary protein. Hypoalbuminaemia reflects depleted body stores and reduced protein synthesis, and is a frequent and serious issue. Protein also plays a leading role in hepatic regeneration. However, dietary protein restriction is indicated in patients with end-stage cirrhosis and hepatic encephalopathy (HE) as the excess contributes to neurotoxins and excess ammonia formation. One study suggests this balance is achievable using a highly digestible protein at 15-20% DM for dogs and 30-35% DM for cats, however if signs of HE are present the recommended values would be lower. The focus should be on providing highly digestible sources of protein. Dairy products, such as cottage cheese, have been recommended as they provide an amino acid composition similar to meat sources with good digestibility and fermentable fibre to decrease nitrogen levels.

In the presence of ascites, portal hypertension and hypoalbuminaemia, sodium and chloride levels should be restricted to levels recommended for renal and cardiac failure: Sodium 0.08 - 0.25% DM for dogs and 0.07-0.3% DM for cats, with chloride typically 1.5 times sodium levels. Excesses of copper or iron and deficiencies of zinc can all contribute to hepatic disease and should be avoided. As free radicals are an important component of most forms of liver damage antioxidants such as vitamins C and E should be included for their protective properties. Complex digestible carbohydrates, such as rice, should provide 30-50% of calories in order to help avert clinical signs of HE, which translates to 45-55% DM for dogs and 30-40% DM for cats.

Chronic Renal Disease

Chronic renal disease is the most common disease affecting the kidneys of cats and dogs. It is recognised as a reduction in function or the presence of kidney damage. Chronic renal disease is classified by means of the IRIS scale, proposed by the International Renal Interest Society to emphasize the continuum of severity of renal injury. The IRIS scale consists of four stages based on serum creatinine and two sub-stages based on proteinuria and blood pressure measurement.

Nutritional management of patients with chronic renal disease, when overt signs exist, includes measures to reduce signs of uraemia and slow progression to later stages of disease. However, the role of nutritional intervention during earlier stages is less well defined. There appears to be no harm in avoiding nutrient excess (e.g. phosphorus) in IRIS Stage 1 but it should be considered by stage 2 in cats and stage 3 in dogs when serum creatinine exceeds 179 µmol/l (Jacob F, et al., 2002; Ross, et al., 2006).

Protein

Avoiding excessive dietary protein helps control clinical signs of uraemia, which usually occur in stage 4 but may appear earlier (Polzin DJ, et al., 2005). However, the role of decreased dietary protein is less clear in those without symptoms of uraemia. Studies have shown that veterinary therapeutic renal diets prolong survival time, decrease uraemic episodes and delay disease progression. However, there are many features of these diets, other than protein content, that could be responsible, such as: decreased phosphorus, restricted sodium, increased fat, increased omega-3 fatty acids. Therefore the exact role and significance of protein remains a topic for debate. Past studies demonstrate very conflicting results, and are often difficult to interpret due to artificially induced disease and flawed study designs.

In the presence of proteinuria, limiting dietary protein is indicated. Higher dietary protein increases renal blood flow and glomerular filtration rate, which may increase filtration of plasma proteins, resulting in proteinuria (Devaux C, et al., 1996). The recommended range for dry matter (DM) protein levels in foods intended for most patients with CKD is 14 to 20% for dogs and 28 to 35% for cats (Forrester, et al., 2010). It is always important to monitor for signs of protein deficiency.

Phosphorus

Phosphorus restriction from IRIS stages 2 onwards is a widely accepted and well proven recommendation, however the mechanism of this protective effect is unknown. One study found that restricted phosphorus levels prolonged survival times while differing protein levels had no effect (Finco, et al., 1992). When managing chronic renal disease recommended phosphorus are 0.3-0.5% DM in dogs and 0.3-0.6% DM in cats (Forrester, et al., 2010).

Sodium

Both excesses and restriction of sodium are poorly tolerated in chronic renal disease due to a progressively limited ability to excrete and balance sodium levels. Care should be taken due to the potential effects on development of hypertension. While the long term effects of altered dietary sodium on patients with naturally occurring renal disease have not been reported, renal therapeutic diets with moderate sodium restriction were associated with increased survival times compared to maintenance diets with higher sodium levels (Ross, et al., 2006). Current recommended sodium levels when managing chronic renal disease are less than 0.3% DM for dogs and less than 0.4% DM for cats.

Omega-3 Fatty Acids

Appropriate levels of omega-3 fatty acids (e.g., eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]) in foods compete with arachidonic acid in several ways to alter eicosanoid production, which is considered to be renoprotective (Brown, et al., 1998). Based on limited canine studies, the recommended range for total omega-3 fatty acid content in foods for canine and feline chronic renal disease patients is 0.4 to 2.5% DM, with an omega-6:omega-3 fatty acid ratio of 1:1 to 7:1 (Forrester, et al., 2010).

Endocrine Disorders

Diabetes mellitus

Approximately 65% of all diabetic cats have type-II (non-insulin dependent) diabetes (Rand & Martin, 2001). However, cats may only be transiently, or permanently, insulin dependent at the time of diagnosis. This is in sharp contrast to dogs; the overwhelming majority have type-I (insulin-dependent) diabetes (Freeman, 2002). Appropriate nutritional support can allow for less medical intervention (Bennett, et al., 2006).

With a greater understanding of the unique protein metabolism in cats, recommendations for dietary management are leading towards high protein, low carbohydrate diets, such as raw food. These diets have resulted in a reduction of > 50% in the amount of insulin required in 8 of 9 cats in one study (Frank, et al., 2001). A further study demonstrated complete cessation of insulin administration for one third of cats (Bennett, et al., 2001), while a comparison between typical adult maintenance diets and a high-protein diet resulted in a greater post-prandial hyperinsulinaemia with maintenance diets, even in cats with normal body weights (Hoenig, et al., 2000). Persistent hyperinsulinaemia on maintenance diets has also been shown to cause decreased mobilisation of fatty acids, potentially leading to weight gain or obesity (Hoenig, et al., 2000).

Dietary carbohydrate should be less than 20% DM in high-protein/low-carbohydrate formulations for diabetic cats. Increased dietary fibre can benefit both dogs and cats with type I and II diabetes mellitus

through improved glycaemic control, ideally around 7% DM (Zicker, et al., 2010). Feeding lower fat foods helps to minimise the risk of complications associated with pancreatitis, control some aspects of hyperlipidaemia and reduce overall calories favouring weight loss. Protein content should be 15-35% DM for dogs and 28-55% DM for cats with consideration to renal function.

Hyperadrenocorticism

Hyperadrenocorticism or Cushing's disease is seen in middle aged to older dogs and can arise from a pituitary-dependent, adrenal-dependent or iatrogenic cause. Symptoms occur as a result of the abnormally high levels of circulating cortisol. 25 to 30% of untreated dogs with pituitary-dependent hyperadrenocorticism have excess serum cholesterol concentrations (Ford & Ludlow, 2010) and secondary hyperlipidaemia (Barrie, et al., 1993). Hyperadrenocorticism has a strong association with obesity so weight control has to be a key feature in management. Therefore a low fat, low fibre, high protein diet is indicated to assist in optimal nutrition for these patients.

Hyperthyroidism

Feline hyperthyroidism was first described in 1979 and has since become the most commonly diagnosed disease of cats over 6 years of age (Scarlett, 1994). Published literature suggests there are numerous nutritional and environmental factors that may be involved in the pathogenesis of hyperthyroidism in cats.

1. **Iodine deficiency:** Iodine is a key element in the synthesis of thyroid hormones. Inadequate iodine intake leads to low circulating thyroid hormone concentrations, which signals the pituitary to increase secretion of thyroid stimulating hormone (TSH). Persistently high TSH levels cause thyroid hyperplasia (Scott, et al., 1961), which over time may lead to thyroid adenomas, which function independently of TSH control. One study showed cats consuming iodine deficient commercial foods to be more than four times as likely to develop hyperthyroidism as those eating iodine-supplemented foods (Edinboro, et al., 2004).
2. **Soy:** Cats have no requirement for soy and are highly unlikely to ever ingest it in the wild (Hamper, et al., 2012) however it is found in many commercial diets. One study showed young healthy cats fed soy had significantly higher serum T4 and free T4 within 3 months (White, et al., 2004). This effect is worsened if concurrent iodine deficiency is present (Doerge & Sheehan, 2002). With the trend to lower iodine levels in cat food over past 2 decades (Edinboro, et al., 2010), could this be contributing to the rising trend in hyperthyroid cases?
3. **Canned foods**: Due to more variable iodine content and potentially thyroid disrupting resins used to line metal cans, canned cat foods may also play a role in the increasing prevalence of feline hyperthyroidism (Edinboro, et al., 2004).

Management during disease

If severe wasting of body mass has occurred due to the increased metabolic state, the fat content of foods may be increased to achieve higher energy density and enhance weight gain (Zicker, et al., 2010). The hypercatabolic state of hyperthyroid cats can cause protein wasting and deficiency necessitating increased dietary intake during the recovery period. However, due to the frequent association with chronic kidney disease there should be a complete evaluation of renal function first. Protein DM levels of 28-45% with digestibility above 85% is sufficient.

Hypothyroidism

Adult-onset hypothyroidism may be the most common endocrine disease affecting dogs with a prevalence estimated at 0.2% (German, 2006). Two forms predominate: immune-mediated lymphocytic thryoiditis and idiopathic atrophy of the thyroid gland. Energy expenditure has been shown to be approximately 15% lower in affected dogs but returns to normal after treatment is initiated (Greco, et al., 1998). Feeding lower fat foods in obese dogs is recommended to favour weight loss and help correct hyperlipidaemia, minimising the risk of associated problems (e.g. atherosclerosis, pancreatitis) (Zicker, et al., 2010).

Cardiovascular Disease

Historically, dilated cardiomyopathy was a major cause of cardiovascular disease in cats, until the discovery of taurine as the principle cause, and subsequent supplementation of commercial foods lead to a marked decline in prevalence. Hypertrophic and restrictive cardiomyopathies are now most common in cats with chronic mitral valvular disease being the most common acquired cardiac abnormality in dogs (Roudebush & Keene, 2010).

Congestive heart failure (CHF) is associated with the retention of sodium, chloride and water; as a result these nutrients are of primary importance in managing these patients. High sodium consumption is a known risk factor for developing heart disease, one study demonstrated that dogs with CHF ate significantly more sodium compared with dogs with no CHF (Freeman, et al., 2003). It is also important to remember as heart disease worsens the ability to excrete excess sodium is severely depressed. In general, dietary sodium levels for cardiovascular disease should be restricted to 0.08 to 0.25% DM for dogs and 0.07 to 0.3% DM for cats. Recommended chloride levels are typically 1.5 times sodium levels. Avoiding excess sodium chloride in cat foods is more difficult than in dog foods because ingredients used to meet the higher protein requirement of cats also contain sodium and chloride and thus increase the sodium chloride content of cat food. L-carnitine deficiency has been associated with dilated cardiomyopathy in dogs and so should be at least 0.02% DM for dogs. Omega-3 fatty acids have been

linked to reducing arrhythmias in boxers and helping to electrically stabilise cardiac cells (Smith, et al., 2007; Leaf, et al., 2005).

Urinary Disease

Feline lower urinary tract disease (FLUTD)

Feline lower urinary tract diseases encompass many diverse causes, the most common of which are:

1. Idiopathic cystitis (FIC)
2. Urolithiasis
3. Urethral plugs

Nutritional management is an important component in managing and preventing recurrence of these conditions, along with environmental enrichment and behavioural management. In an animal health survey prepared for the Morris Animal Foundation, 1,211 owners indicated that their top feline health concerns were urinary diseases (48%) (Forrester, et al., 2010). The most common mineral types identified in feline uroliths are struvite (magnesium ammonium phosphate) and calcium oxalate (Houston, et al., 2003; Cannon, et al., 2007). Obesity is a known risk factor for FLUTD (Cameron, et al., 2004) and so weight management is an important consideration.

Calcium oxalate

Feeding dry food with reduced moisture content and reduced water intake have been associated with increased risk of calcium oxalate uroliths (Lekcharoensuk, et al., 2001), while feeding food of higher moisture content has been associated with a decreased risk (Jones, et al., 1997). A case-controlled study of cats fed high protein diets demonstrated a lower chance of forming calcium oxalate uroliths compared to those fed low protein foods (Lekcharoensuk, et al., 2001). Excessive dietary calcium should be avoided to prevent recurrence; those at risk should not consume dairy produce such as milk and cheese.

Struvite

Urinary pH plays a critical role in managing cats with struvite disease but appears less important in cats with calcium oxalate uroliths. Struvite is highly soluble and is, therefore, less likely to precipitate in acidic urine (pH <6.5). Uroliths form as a result of oversaturation, which can occur in the presence of infection with a urease-producing organism, however in cats it is more commonly a sterile urine. In a study of healthy cats fed three foods to produce different urinary pH values, reducing urinary pH from 6.81 to 6.18 had no significant effect on urine saturation for calcium oxalate but significantly

decreased struvite saturation (Stevenson, et al., 2000). Although acidifying foods have been associated with occurrence of calcium oxalate uroliths in cats, changes in urinary pH values over the physiologic range appear to have little effect on solubility of calcium oxalate. As dietary protein can lead to the increased formation of ammonium, excesses should be avoided. The recommended level for struvite dissolution and prevention ranges from 30-45% DM protein.

The fine balance of dietary mineral concentrations is also key in management of uroliths. Studies show they are best maintained at the recommended levels with both restriction and excesses avoided (Forrester, et al., 2010). The implications can be demonstrated with Magnesium (Mg). Historically, diets to prevent struvite urolithiasis were formulated with very low concentrations of Mg and promoted acidification, however this likely contributed to the increase in proportion of calcium oxalate uroliths. This is because urinary Mg forms complexes with oxalate thus acting as a calcium oxalate inhibitor when present. Effects of omega- 3 fatty acids are also often discussed but have not yet been evaluated in cats or dogs with various lower urinary tract disorders; however, they do appear to have beneficial urinary effects in studies of other species (Forrester, et al., 2010).

Canine lower urinary tract disease

In dogs bacterial cystitis and urolithiasis are the most common urinary diseases, and at times can be interconnected as a result of urease-producing organisms causing oversaturation of struvite and urolith formation. Urolithiasis is a complex entity, often erratic and unpredictable, it cannot be viewed as a single disease. The majority of canine uroliths are comprised of either calcium oxalate or struvite, however there are a number of less common uroliths with varied nutritional recommendations to consider.

Oxalate urolithiasis

Calcium oxalate uroliths accounted for 41% of all canine uroliths submitted to a specialist centre in 2007. Mean age at the time of retrieval was 8.5 years and males were more commonly affected. Miniature schnauzers were overrepresented. Consumption of human food and high sodium treats have been associated with a higher risk due to hypercalciuria, however dietary calcium restriction must always be accompanied by appropriate restriction of dietary oxalic acid to prevent undesirable shifts in intestinal absorption.

Ascorbic acid is a precursor of oxalate so excesses of vitamin C should be avoided, similarly with vitamin D, sodium and magnesium, which can all promote hypercalciuria. Foods high in animal protein may increase urine calcium excretion and decrease urine citrate excretion thereby contributing to calcium oxalate urolithiasis. Hypercalciuria occurs in dogs fed high protein foods (40% DM), the recommended range is 10-18% DM. However, in one study, canned diets with the highest amount of

protein were associated with a decreased risk of calcium oxalate urolith formation, whilst diets with a higher amount of carbohydrate were associated with an increased risk (Lekcharoensuk, et al., 2002).

Struvite urolithiasis

Struvite (magnesium ammonium phosphate) uroliths accounted for 39% of all canine uroliths submitted to a specialist centre in 2007. Mean age at the time of retrieval was 6 years and females were more commonly affected. Struvites can be infection-induced as a result of a urease-producing organism creating alkaline conditions to favour formation of uroliths containing struvite. In contrast, bacterial UTIs are not a consistent finding in dogs with non-struvite uroliths and when they do occur they are often a consequence rather than a cause.

Consumption of moist foods, containing between 75 and 80% water are preferable to increase urine volume and dilute urolith constituents. Acidification of urine to pH 6.0 has been effective in promoting sterile struvite dissolution and protein restriction is not essential for this process, although is often recommended as excess protein intake can increase urea production providing additional substrate for urease. Phosphorus levels during dissolution should not exceed 0.1% DM whereas for prevention levels less than 0.6% DM are recommended. Similarly with magnesium, during dissolution levels should not exceed 0.02% DM and for prevention aim for 0.04% to 0.1% DM.

Purine urolithiasis

Purines are derived from DNA and RNA, they include adenine, guanine, xanthine and uric acid. There are a number of different types of purine uroliths, such as ammonium urate, sodium urate, calcium urate, uric acid and xanthine. Purine uroliths accounted for around 6% of all canine uroliths submitted to a specialist centre and Dalmatians were over-represented at 61% followed by miniature schnauzers, Yorkshire terriers, shih-tzus and English bulldogs.

Dalmatians are predisposed to urate uroliths due to an autosomal recessive trait which reduces their ability to oxidise uric acid to allantoin prior to urinary excretion. They have unique hepatic and renal pathways of metabolism for uric acid but the definitive mechanism of urate urolith formation is unknown. Urate uroliths are 13 times more common in males and the average age of diagnosis is 4.5 years (Albasan, et al., 2005).

Ammonium urate uroliths can also frequently be observed in dogs with portal vascular anomalies such as hepatic shunts. Purine-restricted food is the mainstay for management of both these cases and affected Dalmatians. More than 20% DM protein from sources high in purines increases risk, as does dry foods and acidifying ingredients.

Foods high in purine content: Heart, kidney, liver, salmon, tuna, sardines

Foods low in purine content: Whole grain cereal, butter, fats, cheese, eggs, nuts, sugars

Other

There are a host of other less common uroliths reported such as calcium phosphate, cystine, silica and compound or mixed. Compound uroliths often require surgical intervention and complex nutritional management depending on the exact composition of the nidus and outer shell. Calcium phosphate uroliths provide a similar challenge due to the range of potential underlying causes e.g. hyperparathyroidism, and ineffective dietary dissolution. Nutritional advice follows a similar rationale to calcium oxalate with regard to preventing hypercalciuria.

Cystine uroliths affect males significantly more often than females. Cystine is a non-essential amino acid and is relatively insoluble in acidic urine. Affected dogs have an intestinal defect in amino acid absorption and benefit from restricted protein especially that which contains methionine (a precursor to cystine). Dietary restriction of sodium can also reduce urinary excretion of cystine in dogs.

Silica results from combining silicon, a naturally occurring non-metallic element, with oxygen. Males are affected more commonly with silica uroliths but the initiating and perpetuating causes are unknown so measures for prevention can only be designed to reduce the degree of saturation of urine.

Dermatoses

Disorders of the skin and hair are known to be a very common occurrence in small animal practice. Surveys indicate that 15 to 25% of all small animal practice activity is involved with the diagnosis and treatment of problems with the skin and coat (Scott, et al., 1995). There are multiple dermatoses that can arise as a result of a nutrient deficiency, there is also an element of breed predilection. Ensuring an appropriately balanced diet is the simplest way to prevent such diseases. Providing sufficient quantities of good quality protein is paramount in maintaining healthy skin and haircoats.

Essential fatty acids are commonly used in the management of inflammatory dermatoses. They exhibit multiple anti-inflammatory and immune-modulating properties with the potential to affect allergic skin disease as well as any other inflammatory forms. An initial dose of 50 to 300 mg of total omega- 3 fatty acids/kg body weight/day seemed to be effective in a large number of studies, translating to approximately 0.35 to 1.8% DM.

Cancer cachexia

Cancer is among the most common causes of non-accidental death of dogs and cats (Bonnet, et al., 2005), often resulting in either rapid weight loss or an inability or unwillingness to eat that is difficult to resolve. Cancer cachexia manifests as weight loss, reduced food intake and systemic inflammation

as a consequence of the cancer (Fearon, et al., 2006). This differs from simple starvation as both protein and fat stores are lost simultaneously, compared to the preferential loss of fat stores over protein in starvation.

Diets low in carbohydrates (< 25% DM) are recommended as this is the preferred energy source for tumour cells. High protein and fat levels help replenish the body's lost stores and provide energy to the patient. Dietary protein for dogs of 30-45% DM and for cats 40-50% DM is recommended along with increased fat (25 to 40% DM fat); increased levels of dietary omega-3 fatty acids (>5.0% DM) and an omega-6:omega-3 fatty acid ratio approximating 1:1. Omega-3 fatty acids have an inhibitory effect on tumour growth and a positive correlation with survival time and quality of life (Anderson, et al., 1997; Ogilvie, et al., 2000).

Osteoarthritis

Osteoarthritis is the most commonly observed non-traumatic orthopaedic condition of dogs (Clements, et al., 2006). The most common risk factors in dogs are developmental orthopaedic disease, trauma and obesity. The extent to which the general population of cats is affected by osteoarthritis remains unknown, but it is thought to be common. One study concluded that 90% of cats over the age of 12 years had radiographic evidence of osteoarthritis (Hardie, 1997). Obesity can both cause and exacerbate osteoarthritis and so obesity management is key to nutritional recommendations.

Omega-3 fatty acids reduce the body's capacity to produce pro-inflammatory mediators, instead favouring production of mediators with minimal or no inflammatory effect.

Cognitive dysfunction

Canine cognitive dysfunction syndrome (CDS) describes the behaviour changes noted by owners in their aged pets. It may include disorientation, altered interactions with owners and other pets, disruptions in sleep-wake cycle and house soiling. It is hypothesized that these changes occur as a result of brain ageing. In cats there is a wider and more subtle range of changes seen. Altered activity levels and interactions, aimless activity and excessive vocalization were reported most commonly.

Antioxidants, such as selenium and vitamins C & E, are derived from food sources and help reduce the amount of oxidative damage. Studies have shown diets rich in antioxidants can help improve up to 87% of senile behaviours compared to just 27% for those on a commercial senior diet (Dodd, et al., 2003). Foods rich in omega-3 fatty acids, for their anti-inflammatory properties, and those containing fruit

and vegetables from a variety of sources are recommended. As older dogs commonly suffer concurrent illnesses it is important to always prioritise nutritional requirements.

Epilepsy

Recently dietary therapies to reduce seizures in humans have become a hot topic as a method of reducing anti-convulsant medications required and for the treatment of intractable epilepsy. A ketogenic diet, one that induces a state of ketosis, such as the Atkins diet with high fat, high protein and low carbohydrate content is discussed with successful recent trials (Kossoff, 2004; Neal, et al., 2008).

Dietary changes are known to have the ability to alter the pharmacokinetics of certain drugs, thereby changing the necessary doses required for the desired effect. Phenobarbital, an anti-convulsant, commonly used in the management of canine epilepsy is one such drug. Restricted dietary protein has been shown to not only reduce the activity of enzymes responsible for metabolising phenobarbital but also significantly increase its elimination (Guengerich, 1995; Maguire, et al., 2000). Foods deficient in essential fatty acids also result in decreased rates of drug metabolism; dietary lipids have been reported to be essential for optimal induction of P-450 enzymes by phenobarbital (Fettman, et al., 2010).

Summary

While the flexibility of raw feeding can prove invaluable in achieving tailored nutritional management for a host of disease processes, **we do not intend for it to replace prescription diets** and would always recommend dietary changes should be made under the supervision of a veterinary surgeon.

Disease Process	Nutritional Requirements	Product Recommendations
Senior	✓ Less energy ✓ High digestibility ✓ Balanced micronutrients	➢ NM Original Senior nuggets (dog) ➢ NM Original Senior pouches (dog and cat)
Early development and growth	✓ Increased energy ✓ Essential fatty acids ✓ Appropriate calcium/phosphorus	➢ NM Original Puppy nuggets ➢ Country Hunter Puppy nuggets ➢ NM Original Puppy can and pouch ➢ NM Original Kitten pouch
Obesity	✓ Less energy ✓ High protein/low carbohydrate ✓ L-carnitine	**Dog** ➢ NM Original Light or Senior pouches ➢ Country Hunter Rabbit nuggets ➢ NM Original Senior complete nuggets ➢ NM Original Chicken complete nuggets **Cat** ➢ NM Original Senior Pouch ➢ NM Original Beef & Chicken Pouch
Dietary sensitivities (Food allergies and intolerances)	✓ Single source novel protein ✓ Grain and gluten free	**Dog** ➢ Country Hunter nuggets (excluding Chicken & Salmon, Turkey and Goose, or Beef) ➢ Country Hunter Pouches (Duck and Turkey) **Cat** ➢ Country Hunter pouches (duck/ pheasant and turkey/rabbit)
Gastric dilatation-volvulus (GDV)	✓ High digestibility ✓ Slower consumption ✓ Reduce stress	**Dog** ➢ Feed 2-3 x day ➢ Feed alone ➢ Specialist bowls to slow eating ➢ NM Original and Country Hunter nuggets ➢ Raw meaty bones
Intestinal disease:		
- Diarrhoea	✓ High digestibility ✓ High moisture content to replace losses	➢ See below
- Small Intestinal	✓ High digestibility ✓ Moderate to high protein ✓ Low carbohydrate ✓ Less fat ✓ Avoid high fibre	**Dog** ➢ NM Original Nuggets (Chicken, Banquet, Senior) ➢ Country Hunter Rabbit Nuggets ➢ NM Original Senior or Light Pouch ➢ **Cat** ➢ NM Original Beef & Chicken Pouch ➢ NM Original Senior Pouch

- Large Intestinal	✓ Single source novel protein ✓ Grain and gluten free ✓ High fibre	**Dog** ➢ Country Hunter nuggets (excluding Chicken & Salmon, Turkey and Goose, or Beef) ➢ Country Hunter Pouches (Duck and Turkey) ➢ Country Hunter cans (excluding Beef; Pheasant and Goose; Salmon and Chicken) **Cat** ➢ Country Hunter pouches (duck/ pheasant and turkey/rabbit)
- Flatulence	✓ High digestibility (protein and carbohydrates) ✓ Reduced fibre ✓ Reduce aerophagia	**Dog** ➢ Country Hunter nuggets ➢ NM Original Nuggets
- Anal Gland impaction	✓ Increased fibre ✓ Higher bone content (ground or raw meaty bones) ✓ Obesity management	**Dog** ➢ Country Hunter Nuggets ➢ NM Original Nuggets ➢ Raw meaty bones (2-3 times a week)
Pancreatic disease:		
- Pancreatitis	✓ Low fat ✓ Balanced micronutrients ✓ Antioxidants	➢ **Dog:** If not obese use NM Original Senior nuggets ➢ **Cat:** If not obese NM Original Senior pouch or Beef and Chicken pouch ➢ If obese homemade with <10% DM fat for dogs and <15% cats
- Exocrine pancreatic insufficiency	✓ High digestibility ✓ Low fat ✓ Low fibre ✓ Balanced micronutrients	**Dog** ➢ NM Original Nuggets (Chicken, Banquet or Senior) ➢ Country Hunter Rabbit Nuggets ➢ NM Original Light Pouch **Cat** ➢ NM Original Senior Pouch ➢ NM Original Beef and Chicken Pouch
Hepatobiliary (liver) disease	✓ Highly digestible protein ✓ Lower protein – especially if signs of HE ✓ Antioxidants ✓ Balances micronutrients ✓ High carbohydrate	➢ Homemade: **Dog** 45-55% DM carbs **Cat** 30-40% DM carbs Rice is ideal as digestible ➢ Lower protein ➢ Could add Mighty Mixer to increase carbohydrates
Chronic renal (kidney) disease		
- *No uraemia*	✓ Omega-3 Fatty Acids	**Dog** ➢ NM Original Nuggets
- *Uraemic symptoms* - *Proteinuric*	✓ Decreased dietary protein ✓ Restricted Phosphorus ✓ Moderately restricted sodium ✓ Omega-3 Fatty Acids	➢ Homemade: Dog: 14 to 20% DM protein Cat: 28 to 35% DM protein ➢ Tripe is low in phosphorus

Endocrine (hormonal) disorders:		
- Diabetes mellitus	✓ High protein/low carbohydrate ✓ Increased fibre ✓ Lower fat	**Dog** ➢ NM Original Nuggets (Chicken, Banquet, Senior) ➢ Country Hunter Rabbit nuggets **Cat** ➢ True Instinct Cat Raw Bites ➢ Country Hunter pouches
- Hyperadrenocorticism (Cushings disease)	✓ High protein ✓ Low fat ✓ Low fibre	**Dog** ➢ NM Original nuggets (Chicken, Banquet, Senior) ➢ Country Hunter Rabbit nuggets ➢ NM Original Senior Pouch ➢ NM Original Light Pouch
- Hyperthyroidism	✓ Increased dietary fat ✓ Increased dietary protein ✓ High protein digestibility ✓ Avoid soy ✓ Avoid canned products	**Cat** ➢ True Instinct Cat Raw Bites ➢ NM Original Pouches (Chicken and Turkey; Chicken, Salmon & Tuna)
- Hypothyroidism	✓ Decreased dietary fat ✓ Obesity management	➢ **Dog** ➢ NM Original Nuggets (Chicken, Banquet, Senior) ➢ Country Hunter Rabbit nuggets
Cardiovascular disease	✓ Sufficient taurine (cats) ✓ Low sodium ✓ L-carnitine ✓ Omega-3 fatty acids	**Dog and Cat** ➢ Complete and balanced ranges
Urinary disease:		
- FLUTD (feline lower urinary tract disease)	✓ High moisture ✓ Obesity management ✓ Balanced micronutrients ✓ Omega-3 fatty acids	**Cat** ➢ Complete and balanced pouches ➢ True Instinct Cat Raw Bites ➢ NM Original Beef & Chicken and Senior pouches are lowest fat if obese
- Oxalate urolithiasis	✓ Moderate protein ✓ Low carbohydrate ✓ Avoid micronutrient excesses	**Dog** ➢ NM Original Nuggets **Cat** ➢ NM Original Pouches (Chicken & Turkey; Chicken, Salmon & Tuna) ➢ Country Hunter Pouches ➢ True Instinct Cat Raw Bites
- Struvite urolithiasis	✓ High moisture ✓ Avoid excess phosphorus and magnesium	**Dog** ➢ NM Original Cans and Pouches **Cat** ➢ True Instinct Cat Raw Bites ➢ NM Original Pouches
- Purine urolithiasis	✓ Purine restriction	**Dog** ➢ Homemade: **Avoid** high purine foods, such as heart, kidney, liver, salmon and tuna. **Select** low purine foods, such as butter, dairy and eggs
Dermatoses (skin and hair disorders)	✓ High quality protein ✓ Omega-3 fatty acids ✓ Balanced micronutrients	**Dog and Cat** ➢ Complete and balanced ranges

Cancer cachexia	✓ Low carbohydrate ✓ High protein ✓ High fat ✓ Essential fatty acids	**Dog** ➢ NM Original Active nuggets ➢ Country Hunter nuggets (Duck, Chicken & Salmon, Beef, Turkey & Goose) ➢ Country Hunter Beef Can ➢ Country Hunter Wild Boar Can ➢ Country Hunter Duck Can **Cat** ➢ True Instinct Cat Raw Bites ➢ Country Hunter Pouches
Osteoarthritis	✓ Obesity management ✓ Omega-3 fatty acids	**Dog** ➢ NM Original Light or Senior pouches ➢ Country Hunter Rabbit nuggets ➢ NM Original Senior nuggets ➢ NM Original Chicken nuggets **Cat** ➢ NM Original Senior Pouch ➢ NM Original Beef & Chicken Pouch
Cognitive dysfunction	✓ Antioxidants ✓ Omega-3 fatty acids	**Dog** ➢ NM Original Senior nuggets and pouches ➢ Country Hunter nuggets **Cat** ➢ True Instinct Cat Raw Bites ➢ Country Hunter Pouches ➢ NM Original Senior Pouch
Epilepsy	✓ High protein ✓ High fat ✓ Low carbohydrate ✓ Essential fatty acids	**Dog** ➢ NM Original Active nuggets ➢ Country Hunter nuggets (Duck, Chicken & Salmon, Beef, Turkey & Goose) ➢ Country Hunter Beef Can ➢ Country Hunter Wild Boar Can ➢ Country Hunter Duck Can **Cat** ➢ True Instinct Cat Raw Bites ➢ Country Hunter Pouches

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