



Nutritional Therapy for Chronic Kidney Disease in Dogs

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Nutrition is arguably the most important aspect of chronic kidney disease (CKD) management. By manipulating the composition of a patient's diet, we can slow the progression of disease, minimize uremic clinical signs, and improve quality of life. A seminal study in dietary management of CKD demonstrated dogs with spontaneous CKD lived an average of 13 months longer when fed a diet designed for renal disease compared to a maintenance diet. In addition, eating the renal diet carried a 3-fold reduction in relative risk of uremic crises compared to eating the maintenance control

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diet. At the end of the 2-year study, only 33% of dogs receiving the renal diet died from renal-related causes compared to 65% of dogs eating the maintenance diet.¹ Most therapeutic diets designed for CKD utilize a combination of moderately restricted protein, phosphorus, and sodium with moderately elevated concentrations of omega-3 fatty acids and potassium (Table 1). Below we explore the evidence behind these nutrient alterations.

Protein

The goals behind lowering the concentration of protein in diets fed to dogs with CKD are to lower the amount of nitrogenous waste products produced during protein metabolism while also minimizing the amount of protein entering the glomerular filtrate of the kidneys. The restriction of protein as a dietary management strategy for CKD has become increasingly controversial. Some argue dogs with kidney disease should not be fed a low protein diet in an effort to retain muscle mass

and increase diet palatability while others cite research suggesting lower protein diets in combination with other nutrient modifications reduce morbidity and prolong lifespan.¹⁻³

Azotemia and Uremia. Creatinine and blood urea nitrogen (BUN) are waste products of protein and muscle metabolism cleared through the kidneys. Elevations of these markers, along with other by-products of protein metabolism not routinely measured in blood samples, result in azotemia and clinical signs associated with uremia. In addition to causing nausea, inappetence, and malaise, nitrogenous wastes can also contribute to gastric ulceration, reduce red blood cell lifespan,⁴ and exacerbate polyuria and polydipsia through excess solute load in the kidney. Reduction of dietary protein intake may lower the concentration of these uremic toxins in dogs.

Most studies evaluating protein restriction in dogs with CKD are based on the remnant kidney model instead

of naturally occurring disease.^{2,3} Moderate protein and phosphorus restriction (35 g and 750 mg per 1000 kcal, respectively) reduced morbidity and mortality in beagles with induced CKD while high protein intake (110 g/1000 kcal) worsened clinical signs and increased death rates. Low protein diets containing 17 g/1000 kcal lowered plasma protein and albumin concentrations.^{2,3} Unfortunately it is difficult to determine the true impact of dietary protein in these studies as the diets varied in caloric density, phosphorus, sodium, and protein digestibility.

Proteinuria. Based on the intact nephron hypothesis, once a critical mass of nephrons is reached, remaining nephrons hypertrophy and signal the need for increased blood flow, glomerular filtration rate, and pressure. The chemical and electrical selective barriers of the glomeruli are impaired and increased levels of protein pass into the filtrate. Eventually the tubular reabsorption of protein is overwhelmed and tubular cells begin to secrete inflammatory mediators that further damage the kidneys.⁵

Protein-restricted diets have been shown to reduce glomerular damage and urinary protein concentrations in dogs with hereditary nephritis.^{6,7} The amount of protein restriction needed to mitigate renal damage secondary to proteinuria in dogs is unclear. For example, when dogs with nephritis ate diets containing 72 or 33 grams of protein per 1000 kcal, mean urine protein to creatinine ratios were 4.7 and 1.8, respectively. However, dogs on the lower protein

diet also had reductions in albumin and body weight.⁷ A more recent study evaluated a renal diet in combination with ACE inhibitors in proteinuric CKD dogs and saw no change in albumin or body condition score over a 5-month period.⁸ Careful consideration of dietary protein intake is required in dogs with proteinuria and current protein intake should be considered. For example, a proteinuric dog currently eating a high protein diet may see substantial improvement from reducing his dietary protein intake by 25% to 50%. Careful monitoring and assessment of other clinical signs are needed to balance protein losses and renal damage in these patients.

Dietary Protein Requirements. When assessing the protein content of a diet, it is important to remember that animals actually require amino acids, rather than protein.

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By feeding high quality protein sources with well-balanced ratios of essential amino acids, we can lower the overall protein content of the diet while preventing protein malnutrition. It is also important to note that all diets currently marketed for

management of CKD in dogs exceed the recommended amounts set by the National Research Council.⁹

More studies are needed to determine if lowering dietary protein to the level of most renal diets is critical for managing CKD, or if alterations in phosphorus or omega-3 fatty acids are providing most of the improvement seen in research studies to date. Based on the evidence currently available, diets providing approximately 35 g/1000 kcal of high-quality protein combined with other dietary modifications improve and prolong the life of dogs with CKD^{1,2} while providing adequate protein to support albumin production^{1,3} and maintain body weight.³

Phosphorus

While there is still much to learn regarding the need for and extent of protein restriction that is optimal for dogs with CKD, the need for phosphorus restriction is less controversial. As the kidney retains phosphorus, the parathyroid gland is stimulated to release parathyroid hormone (PTH) to increase phosphorus excretion by the kidney. However, PTH also stimulates the release of phosphorus from the bone, which exacerbates hyperphosphatemia. In addition, calcitriol deficiency occurs secondary to decreased renal production of 1- α -hydroxylase and hyperphosphatemia. This process ultimately leads to calcium deficiency and increased PTH production. Studies have shown that by reducing phosphorus in the diet, we can reduce hyperphosphatemia and the sequela of renal secondary hyperparathyroidism.

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The importance of phosphorous restriction was demonstrated by a study in which 24 dogs with induced kidney disease were fed a diet with 32% protein dry matter with and without phosphorus restriction over two years. Dogs on the high phosphorus diet had lower survival rates (33%) compared to the restricted phosphorous group (75%).¹⁰

Other Nutrients

Other nutrients to consider with renal disease are sodium, potassium, and omega-3 fatty acids. Sodium restriction has been recommended as a method to combat hypertension associated with CKD. However, studies that demonstrate sodium reduction improves hypertension are lacking in dogs. Hypokalemia is a well-recognized consequence of renal disease in dogs and most prescription renal diets have moderately high levels of potassium. Though more common with acute kidney injury, some dogs with CKD can become hyperkalemic and may need a formulated potassium-restricted homemade kidney diet.

Omega-3 fatty acids in the form of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) competitively inhibit the formation of pro-inflammatory leukotrienes and prostaglandins by omega-6 fatty acids. Diets high in omega-3 fatty acids have been shown to reduce

glomerular capillary pressure and proteinuria, and abate the decline of glomerular filtration rate (GFR) in dogs with experimentally induced CKD.¹¹ A dosage of 40 mg/kg EPA combined with 25 mg/kg DHA per day has been recommended for dogs with CKD.¹² This equates to approximately 1 gram of EPA and DHA per 1000 kcal of diet when fed at a 1.4 times resting energy requirements for adult maintenance. Some foods are supplemented with high concentrations of the omega 3 fatty acid alpha-linolenic acid (ALA). While this is an essential fatty acid for dogs, the conversion of ALA to EPA and DHA is poor, and consideration of omega 3 fatty acid doses should not be based on ALA concentrations.

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Additional Considerations

Although renal diets are a critical part of managing CKD, several factors can limit their use. Although renal diets tend to have high palatability, as renal failure progresses animals tend to become hyporexic. It is important to minimize food aversions as much as possible by avoiding renal diets when patients are nauseated

or stressed in the hospital setting. As a dog becomes more averse to eating, it may be necessary to try different flavors or brands, or to have a homemade diet formulated by a nutritionist. If a patient is unable to meet their energy requirements, a feeding tube may be useful for supplying calories, medications, and/or fluids. Homemade diets can also be used for clients opposed to feeding conventional pet foods or if a patient has multiple diseases that cannot be managed with a commercial renal diet (e.g., a dog with CKD and pancreatitis, requiring a low fat diet). While homemade diets can be useful for managing CKD in dogs, a board-certified veterinary nutritionist should formulate them.

Summary

There is still much to learn about the nutritional needs of dogs with CKD. While the combination of moderately low protein, low phosphorus, moderate sodium, and moderately high potassium and EPA/DHA has proven to reduce uremia and extend the lifespan of dogs with CKD, controversy remains regarding the optimal dietary protein concentration for dogs with this disease. Dogs with early stages of CKD will likely tolerate less protein restriction than dogs with severe azotemia. In addition, hyporexia induced by CKD may play a more important role in muscle wasting seen in patients eating a therapeutic renal diet. Until further evidence is available, dogs with azotemic or proteinuric CKD will benefit from a therapeutic diet designed for renal disease and every effort, including use of feeding tubes, should be made to maintain adequate caloric intake.

TABLE

NUTRIENT PROFILE OF TYPICAL THERAPEUTIC DIETS DESIGNED FOR CKD MANAGEMENT

Nutrient (g/1000 kcal)	Therapeutic CKD diets	AAFCO*	NRC recommended allowance for adult dogs⁹
Protein	31-41	45	45
Fat	40-62	14	14
Phosphorus	0.5-0.8	1.0	1.0
Potassium	1.1-2.3	1.5	1.5
Sodium	0.4-1.2	0.2	0.2
EPA + DHA	0.4-1.2	n/a	n/a

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