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ARTICLE

# NUTRITIONAL MANAGEMENT OF CHRONIC KIDNEY DISEASE IN CATS & DOGS

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Nutritional intervention is a cornerstone in the treatment of patients with chronic kidney disease (CKD). However, a complete nutritional assessment and staging of the patient's kidney disease are indicated before any dietary recommendations are made (**Table 1**). Guidelines for complete nutritional assessment are available through the World Small Animal Veterinary Association.<sup>1</sup>

The International Renal Interest Society (IRIS) recommends nutritional intervention in both cats and dogs at IRIS stage 2, but in my opinion, a diet change at IRIS stage 1 may be required once a complete assessment of the patient has been performed. IRIS guidelines are available at:

- Staging of CKD: [iris-kidney.com/guidelines/staging.aspx](http://iris-kidney.com/guidelines/staging.aspx)
- Treatment recommendations for CKD: [iris-kidney.com/guidelines/recommendations.aspx](http://iris-kidney.com/guidelines/recommendations.aspx).

## EFFICACY OF THERAPEUTIC DIETS

Therapeutic kidney diets are used to improve a patient's quality of life by controlling signs of

TABLE 1.  
**Nutritional Assessment Checklist for Patients with Chronic Kidney Disease**

<b>Diet history</b>	Appetite Current diet Evaluation of current protein intake Treats/table foods Foods for medication administration Supplements
<b>Laboratory values</b>	Creatinine Blood urea nitrogen Phosphorus Potassium Albumin Bicarbonate (HCO <sub>3</sub> ) Urine specific gravity Urine protein-to-creatinine ratio
<b>Patient assessment</b>	Body weight Body condition score Muscle condition score Systolic blood pressure

uremia and increasing life span by altering disease progression.

Double-blinded, randomized, controlled clinical trials have compared the effectiveness of diets formulated for CKD with adult maintenance diets in dogs and cats. The studies evaluated characteristics of therapeutic kidney diets, such as reduced phosphorus, protein, and sodium and the addition of omega-3 fatty acids (eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]) (**Table 2**).

#### In the Literature: Cats

In a study by Ross and colleagues, cats with spontaneous IRIS stage 2 and 3 CKD were fed a therapeutic kidney diet ( $n = 22$ ) or an adult maintenance diet ( $n = 23$ ) and evaluated for 24 months.<sup>2</sup> In the therapeutic diet group, no cats experienced a uremic crisis and no renal-related deaths occurred, whereas, in the maintenance diet group, 26% of cats had uremic crisis and 21.7% of cats died of renal-related causes.

In a study by Elliott and colleagues, client-owned cats with spontaneous stable CKD were fed a therapeutic kidney diet ( $n = 29$ ) or an adult maintenance diet ( $n = 21$ ).<sup>3</sup> Those fed a maintenance diet received one because they refused a therapeutic kidney diet or their owners did not want to change their diet. Feeding a therapeutic kidney diet helped reduce plasma phosphate, blood urea nitrogen, and parathyroid hormone concentrations. The median survival time for cats receiving a therapeutic kidney diet was 633 days (1.7 years) compared with 264 days (0.7 years) for cats receiving a maintenance diet.

#### In the Literature: Dogs

In a study by Jacob and colleagues, dogs with

spontaneous IRIS stage 2 or greater CKD were fed a therapeutic kidney diet ( $n = 21$ ) or adult maintenance diet ( $n = 17$ ) and evaluated for 24 months.<sup>4</sup> Dogs in the therapeutic kidney diet group had a median time to uremic crisis of 615 days (1.7 years) and a median time of 594 days (1.6 years) before deaths occurred, while those in the maintenance diet group had median times to uremic crisis of 252 days (0.7 years) and 188 days (0.5 years) before deaths occurred, respectively. At the end of the study, only 33% of dogs in the therapeutic kidney diet group died of a renal-related cause compared with 65% of dogs in the maintenance group.

#### KEY NUTRIENTS FOR CKD

Key nutrients that need to be considered when feeding patients with CKD include:

- Protein
- Phosphorus
- Omega-3 fatty acids
- Sodium
- Potassium.

Additional nutrient considerations include fat, acid–base balance, antioxidants, and fiber.

In the November/December 2015 issue of *Today's Veterinary Practice*, the article—**The Protein Paradigm: Assessing Dietary Protein in Health & Disease**—provided an in-depth discussion of the implications of dietary protein in both healthy dogs and cats and those affected by obesity, urinary tract and kidney disease, food allergies, and liver disease.

#### DIETARY PROTEIN

Protein restricted diets are commonly recommended for the management of CKD in both cats and dogs.

TABLE 2.

#### Ranges of Dietary Components in Typical Therapeutic Renal Diets

COMPONENT	THERAPEUTIC RENAL DIETS	AAFCO MINIMUM*	THERAPEUTIC RENAL DIETS	AAFCO MINIMUM*
	DOGS		CATS	
<b>Protein</b> (g/1000 kcal)	25-55	45	58-82	65
<b>Phosphorus</b> (g/1000 kcal)	0.4-1.2	1	0.8-1.35	1.25
<b>Sodium</b> (g/1000 kcal)	0.4-1.2	0.2	0.5-1	0.5
<b>Potassium</b> (g/1000 kcal)	0.8-2.1	1.5	1.4-2.6	1.5
<b>EPA + DHA</b> (g/1000 kcal)	32-1200	n/a	31-1910	n/a

\* 2016 AAFCO adult dog maintenance minimum

TABLE 3.

**Protein Requirements & Levels in Adult Cats & Dogs**

	NRC MINIMUM REQUIREMENT	NRC RECOMMENDED ALLOWANCE	AAFCO MINIMUM	LOW PROTEIN	MODERATE PROTEIN	HIGH PROTEIN
<b>Cats</b>	40	50	65	< 80	80-120	> 120
<b>Dogs</b>	20	25	45	< 60	60-90	> 90

**Notes**

- Values in table are expressed as g/1000 kcal.
- Low, moderate, and high descriptors are a general comparison among commercial pet foods.

The primary reasons a protein restricted diet is recommended include reduction in nitrogenous wastes and glomerular proteinuria.

Nitrogenous wastes can contribute to:

- Clinical signs associated with azotemia and uremia
- Polyuria and polydipsia; reduction in nitrogenous wastes can improve polyuria and polydipsia by reducing the solute load to the kidney
- Anemia through gastrointestinal ulceration and blood loss. Nitrogenous wastes may also shorten the life span of red blood cells<sup>5</sup> and cause platelet dysfunction<sup>6</sup> as demonstrated in the human literature.

However, the necessity of protein restriction for both dogs and cats has remained a point of controversy and discussion for many years. This includes the timing at which protein restriction should occur and the provision of sufficient dietary protein to avoid protein malnutrition and loss of lean body mass. The role of protein restriction in the progression of CKD in both cats and dogs is unclear.

**Protein Requirements**

Protein requirements for adult dogs and cats have been established through use of nitrogen balance studies, wherein nitrogen intake is equivalent to nitrogen loss. The National Research Council (NRC) Ad Hoc Committee on Dog and Cat Nutrition has established minimum requirements and recommended allowances in adult cats and dogs based on these types of studies (Table 3).<sup>7</sup>

The Association of American Feed Control Officials (AAFCO) also recommends a minimum crude protein content for adult dogs and cats, taking into account not only recommendations from the NRC for healthy adults but also changes in protein digestibility that occur during the processing of pet food (Table 3).<sup>8</sup>

A more recent study evaluated the protein re-

quirement of adult cats based on the maintenance of lean body mass.<sup>9</sup>

- Nitrogen balance was achieved with a diet containing 56 g protein/1000 kcal. Nitrogen balance can be achieved on a low protein diet; however, this may be at the expense of lean body mass through the utilization of endogenous proteins. A diet containing 95 g protein/1000 kcal was needed to maintain lean body mass.
- On the basis of regression analysis, the researchers suggested that, although 1.5 g protein/kg body weight is required for nitrogen balance in adult cats, 5.2 g/kg is recommended to maintain lean body mass.

This study was performed in healthy adult male cats, and additional studies are needed to evaluate the protein requirement to maintain lean body mass in dogs and cats with CKD.

**Protein Restriction**

The amount of protein needed to achieve restriction is not clearly defined. Categories for low, moderate, and high protein diets are provided<sup>10</sup> (Table 3) but, for some animals, protein restriction may be relative to their current intake based on an accurate diet history (see **Examples of Protein Restriction Relative to Current Intake**). In addition, protein restriction does not equate to feeding below the established NRC minimum nutritional requirements.

At this time, typical therapeutic diets labeled for various stages of CKD range from 25 to 55 g/1000 kcal for dogs and 58 to 82 g/1000 kcal for cats, with allowance for some tailoring of protein content to a patient's needs.

**Proteinuria in Dogs**

In dogs with proteinuria secondary to glomerular disease, the American College of Veterinary Internal Medicine Consensus Statement recommends reduced protein intake.<sup>11</sup>

In dogs with hereditary nephritis, feeding a protein restricted therapeutic renal diet reduced structural damage to glomeruli by decreasing glomerular basement membrane splitting and delaying the progression of renal failure.<sup>12</sup> In both humans and rats, protein causes direct injury to the tubulointerstitium through release of vasoactive and inflammatory substances that trigger renal scarring and loss of function.<sup>13</sup>

Additional studies have shown that dogs with spontaneous CKD and urine protein-to-creatinine ratios (UPCs) of 1 or greater are at increased risk for uremic crisis and death compared with dogs that have UPCs less than 1.<sup>14</sup> In dogs with inherited glomerulonephropathy, proteinuria was reduced significantly when they were switched from a diet containing 72 g protein/1000 kcal to one containing 33 g protein/1000 kcal, but this finding was not evaluated in relation to patient morbidity and mortality.<sup>15</sup>

A reduction in dietary protein intake by 25% to 50%, based on severity of proteinuria, azotemia, and clinical signs, has been recommended.<sup>16</sup>

### Proteinuria in Cats

Proteinuria is inversely associated with survival in azotemic cats and significantly associated with the development of azotemia in nonazotemic cats.<sup>17,18</sup> Studies investigating the role of reduced protein diets in cats are limited to those with confounding dietary variables, such as phosphorus restriction. As a result, the independent influence of protein on disease progression in these patients is not well known.

### Later Stage CKD

In both dogs and cats with IRIS stages 3 and 4 CKD, reduced protein intake may help reduce accumulation of nitrogenous wastes from protein metabolism that contribute to azotemia and uremia. High protein intake may exacerbate uremia, contributing to the morbidity associated with CKD.

Studies in both dogs and cats with CKD have demonstrated that modifying protein intake reduces blood urea nitrogen.<sup>2,3</sup> While urea is not a major uremic toxin in cats and dogs, it is a marker for nitrogenous wastes that contribute to uremia. Additionally, hyporexia, which occurs commonly with late stage CKD and/or suboptimal protein intake, can increase the production of uremic toxins through endogenous protein catabolism.



### Examples of Protein Restriction Relative to Current Intake

Two 10-kg spayed female mixed breed dogs with glomerular proteinuria and IRIS stage 1 CKD are consuming approximately 550 kcal/day (calculation,  $1.4 \times (70 \times \text{kg body weight}^{0.75})$ ). Diet recommendations are listed in **Table 4**.

#### Dog A

Diet history:

- Adult maintenance dry food (100 g protein/1000 kcal); consuming approximately 500 kcal/day for a total of 50 g protein/day
- ¼ cup boiled, chopped, boneless, skinless chicken breast; consuming approximately 53 kcal and 10 g protein/day
- No other treats or table foods provided
- Total protein intake approximately 60 g protein/day or 109 g protein/1000 kcal

#### Dog B

Diet history:

- Adult maintenance dry food (60 g protein/1000 kcal); consuming approximately 525 kcal/day for a total of 31.5 g protein/day
- One commercial dog treat (20 g protein/1000 kcal); consuming approximately 25 kcal/treat and 0.5 g protein/day
- No other treats or table food provided
- Total protein intake approximately 32 g protein/day or 58 g protein/1000 kcal

TABLE 4.

### Dietary Recommendations for Protein Restriction

DOG	PROTEIN REDUCTION	DIETARY NEEDS	RECOMMENDED DIET
<b>Dog A</b>	25%–50% reduction	Diet containing approximately 54–82 g protein/1000 kcal	<ul style="list-style-type: none"> <li>• Commercial adult maintenance dry food (containing 60 g protein/1000 kcal)</li> <li>• Discontinuation of chicken breast</li> </ul>
<b>Dog B</b>	25%–50% reduction	Diet containing approximately 29–44 g protein/1000 kcal	<ul style="list-style-type: none"> <li>• Therapeutic renal diet (containing 39 g protein/1000 kcal)</li> <li>• One current commercial dog treat/day</li> </ul>

### Cachexia

Cachexia—loss of lean body mass—is common in patients with CKD and may alter strength, immune function, wound healing, and overall survival.<sup>19</sup> Although the overall prevalence of renal cachexia is unknown in dogs and cats, a recent study found that underweight dogs—those with a body condition score (BCS) of 1 to 3 out of 9—had reduced survival compared with dogs with a BCS of 4 or greater.<sup>20</sup>

Prevention of cachexia and protein malnutrition are the primary reasons clinicians debate protein restriction. Each patient should be assessed individually for signs of cachexia, and protein intake should be balanced in light of proteinuria and uremia.

### Further Defining Protein's Role

The role of protein restriction in the progression of CKD in dogs and cats is not clear at this time and requires further investigation.

- In studies demonstrating improved survival times in dogs and cats receiving a therapeutic kidney diet compared with those eating a maintenance diet, the benefit of protein restriction cannot be separated from the benefits of phosphorus restriction and other characteristics of therapeutic kidney diets.
- In the veterinary literature, no definitive conclusion has been reached regarding which diet is more beneficial for dogs and cats with CKD: a diet with unrestricted protein but the remaining features of therapeutic renal diets or a protein restricted therapeutic renal diet. This is likely dependent on the IRIS stage and substage of disease.

### DIETARY PHOSPHORUS

Phosphorus retention and subsequent hyperphosphatemia are common in patients with CKD due to decreased glomerular filtration. This results in renal secondary hyperparathyroidism and calcitriol deficiency, and can lead to soft tissue mineralization and fibrous osteodystrophy.

#### Phosphorus Restriction

Phosphorus restriction, independent of other nutritional factors, delays progression of CKD; thus, it is a vitally important nutrient, if not the most important, with regard to nutrition for patients with renal disease. Due to the high phosphorus content of many meat-based proteins, reducing protein content also helps reduce the total phosphorus content of a diet.

Maintenance diets often contain added phosphorus beyond that found in protein because, in healthy animals, phosphorus deficiency is more concerning than excess phosphorus. While maintenance diets generally contain greater than 1.5 g/1000 kcal of phosphorus, the phosphorus content of typical therapeutic diets labeled for various stages of CKD ranges from 0.4 to 1.2 g/1000 kcal and 0.8 to 1.35 g/1000 kcal for dogs and cats, respectively.

### In the Literature

In a study by Finco and colleagues, 24 dogs with induced kidney disease were divided into 2 groups and fed one of the following diets<sup>21</sup>:

- Phosphorus restricted diet (0.44% dry matter basis (DMB); estimated 1.1 g/1000 kcal based on a 4000 kcal/kg DMB)
- High phosphorus diet (1.44% DMB; estimated 3.6 g/1000 kcal).

Over a 24-month period, dogs receiving the high phosphorus diet had significantly lower glomerular filtration rates and decreased survival compared with those in the phosphorus restricted group (survival, 33% versus 75%).

In a study by Ross and colleagues, cats with induced kidney disease were also divided into 2 groups and fed either a normal or low phosphorus diet.<sup>22</sup> Those that received a:

- Normal phosphorus diet (1.56% DMB; estimated 3.9 g/1000 kcal based on a 4000 kcal/kg DMB) had evidence of renal mineralization, fibrosis, and mononuclear cell infiltrates
- Low phosphorus diet (0.24% DMB; estimated 0.6 g/1000 kcal) had mild to no histologic changes.

### IRIS Recommendations

IRIS recommends maintaining plasma phosphate concentrations:

- Between 2.7 and 4.6 mg/dL (0.9–1.5 mmol/L) for patients with IRIS stage 2 CKD
- Less than 5 mg/dL (1.6 mmol/L) and less than 6 mg/dL (1.9 mmol/L) for patients with IRIS stages 3 and 4 CKD, respectively.

If hyperphosphatemia persists despite dietary phosphorus restriction, then an enteric phosphate binder, such as aluminum hydroxide, is recommended with each meal. Plasma phosphate concentrations should be monitored every 2 to 4 weeks until the target concentration is achieved.

### OMEGA-3 FATTY ACIDS

Supplementation with polyunsaturated omega-3 fatty acids (EPA and DHA) exerts renoprotective effects.

### In the Literature

Dogs with experimentally induced renal disease fed a diet supplemented with a high dose of fish oil had reduced proteinuria, creatinine, and histopathologic lesions (decreased mesangial matrix expansion, glomerulosclerosis, and renal interstitial cellular infiltrates) compared with those fed diets supplemented with safflower

oil or beef tallow.<sup>23</sup> All diets with supplemental fat had an overall content of 16.8% fat on a DMB (approximately 42 g/1000 kcal assuming the diet contained 4000 kcal/kg on a DMB in which the base diet contained 1.8% fat DMB, or approximately 4.5 g/1000 kcal).

Fewer data are available in cats, although a retrospective study reported that cats on a therapeutic kidney diet with a higher concentration of EPA had longer survival times compared with cats receiving other therapeutic kidney diets.<sup>24</sup>

### Feeding Recommendations

A standard dosage of 40 mg/kg EPA plus 25 mg/kg DHA Q 24 H is recommended for both dogs and cats with CKD, which is approximately 1.16 to 1.18 g of EPA plus DHA/1000 kcal of diet for a cat consuming 1.2 $\times$  and a dog consuming 1.4 $\times$  its resting energy requirement (RER) for adult maintenance. Recently, a specific dose of 140 mg EPA plus DHA/(kg body weight)<sup>0.75</sup> or 790 mg EPA plus DHA/10 kg body weight has been recommended in dogs with CKD.<sup>25</sup>

Companies often add omega-3 fatty acids, including EPA, DHA, and alpha-linolenic acid, to therapeutic kidney diets. However, alpha-linolenic acid is insufficiently converted to EPA and DHA in both dogs and cats. Therefore, if additional supplementation is considered and EPA and DHA levels on a g/1000 kcal basis are not available, contacting the manufacturer is recommended.

### DIETARY SODIUM

Reducing sodium intake may be beneficial in patients with CKD due to sodium retention and the potential for systemic arterial hypertension.

At this time, no evidence suggests that decreasing dietary sodium reduces arterial blood pressure in cats and dogs. Recent studies in healthy aged cats without CKD did not demonstrate an effect of a high sodium diet (3.1 g/1000 kcal) compared with a lower sodium diet (1 g/1000 kcal) on renal function or arterial blood pressure.<sup>26,27</sup> However, these studies have not been performed in cats with CKD.

Increased plasma aldosterone concentration was noted in dogs with asymptomatic chronic valvular disease that were fed a diet containing 0.32 g sodium/1000 kcal fed for 4 weeks.<sup>28</sup> Diets significantly reduced in sodium may activate the renin-angiotensin-aldosterone system, which could be detrimental to patients with CKD, although

further studies are needed.

The sodium content of typical therapeutic diets labeled for various stages of CKD ranges from 0.4 to 1.2 g/1000 kcal for dogs and 0.5 to 1 g/1000 kcal for cats.

### DIETARY POTASSIUM

#### Hypokalemia in Cats

Hypokalemia is common in cats with CKD, and diets formulated for CKD may provide supplemental potassium beyond that added to maintenance diets. The typical potassium content of therapeutic kidney diets for cats ranges from 1.4 to 2.6 g/1000 kcal.

Maintaining the plasma potassium concentration in the middle or upper half of the laboratory reference range is recommended. Oral supplementation with potassium gluconate (2 mEq/kg PO Q 12 H) or potassium citrate (75 mg/kg PO Q 12 H) is recommended if persistent hypokalemia is noted despite feeding an appropriate therapeutic diet.

#### Hyperkalemia in Dogs

Although hyperkalemia is typically associated with acute kidney failure, it may be a complication in some dogs with CKD. Hyperkalemia has been corrected in dogs with CKD by feeding home-prepared potassium reduced diets (0.91  $\pm$  0.14 g/1000 kcal).<sup>29</sup> Therapeutic kidney diets for dogs contain 0.8 to 2.1 g/1000 kcal; therefore, some (although limited) commercial therapeutic kidney diets provide potassium within a range reported to correct hyperkalemia in dogs. Consultation with a board-certified veterinary nutritionist for home-prepared diet formulation should be considered if hyperkalemia persists in a dog with CKD.

### OTHER DIETARY COMPONENTS

Therapeutic kidney diets also feature the following characteristics:

- Calorie dense and moderate to high levels of dietary fat; these characteristics promote increased caloric intake in animals that may be prone to hyporexia and help maintain palatability when protein is reduced
- Supplementation with alkalizing agents, such as potassium citrate, to help correct metabolic acidosis, which can worsen hypokalemia (especially in cats)
- Increased levels of antioxidants, such as vitamins C and E, to reduce renal oxidative stress



### Role of Body Condition in Patients with CKD

Underweight dogs (BCS, 1 to 3/9) with IRIS stages 2 to 4 CKD had significantly shorter survival times compared with dogs of moderate body weight (BCS, 4 to 6/9) and overweight dogs (BCS, 7 to 9/9); survival did not differ between moderate weight and overweight dogs.<sup>16</sup>

- Underweight dogs and cats should be fed to gain weight or, if warranted, should receive assisted feeding to facilitate intake of calories.
- Dogs and cats with ideal body weight should be fed to maintain their current body weight. Feeding amounts should be adjusted if body weight decreases or muscle condition score changes.
- Overweight/obese dogs and cats must be assessed on an individual basis.

Overweight or obese dogs and cats may have more muscle mass to protect against catabolic disease processes, such as CKD, although further research is needed to explore this hypothesis. Generally, use of a therapeutic kidney diet takes precedence in dogs and cats with later stage CKD. In obese dogs and cats with early stage CKD (IRIS stage 1 ± 2), a weight loss plan may be considered after a complete nutritional assessment and only if close monitoring is available.

If progression of CKD is noted, active weight loss should be suspended and appropriate diet modifications should occur until further evaluation. Consultation with a board-certified veterinary nutritionist is recommended for obese patients with CKD.

- Added soluble fiber to promote colonic bacterial growth and utilization of nitrogen and urea; soluble fiber may also be beneficial in cats with constipation, a common complication in cats with CKD.

### FEEDING A PATIENT WITH CKD

#### Therapeutic Diets

Several therapeutic kidney diets in a variety of forms, flavors, and textures are available for both cats and dogs. Introducing a patient to a therapeutic kidney diet is recommended before signs of uremia occur, although this is not always possible.

Samples of various therapeutic diets should be sent home with patients to establish their preferences after diagnosis. Use caution when introducing a therapeutic kidney diet to a hospitalized patient because this may lead to aversion to a diet suggested for long-term feeding.

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### Feeding Tubes

Feeding tubes can be useful, especially with patients in uremic crisis. Liquid enteral formulations within the recommended nutrient criteria are advised for nasoesophageal or nasogastric feeding tubes. When esophagostomy or gastrostomy feeding tubes are in place, a slurry of a canned therapeutic diet is recommended.

To improve the caloric density of a slurry and decrease the volume of slurry administered, use of a liquid enteral diet rather than water is recommended to create a slurry with the selected canned diet. Ideally, the liquid diet should be phosphorus restricted. Most liquid diets designed for over-the-counter use in humans and in convalescent veterinary patients contain less than 1.5 g phosphorus/1000 kcal.

Water needs and medications can also be supplied through the feeding tube.

### Home-Prepared Diets

A home-prepared diet may be useful in patients with poor or selective appetites. Referral to a board-certified veterinary nutritionist is recommended for formulation. Evaluation of home-prepared diets from books and websites has revealed many inadequacies; therefore, these diets are not recommended.<sup>30</sup> These inadequacies include:

- Lack of specificity for ingredients and supplements
- No specification for type or severity of disease
- Inadequate protein, or deficiency in at least one amino acid for 76.9% of recipes for dogs and 42.9% of recipes for cats
- Mineral inadequacies, including calcium deficiency (56.4% of canine and 25% of feline recipes).

Before referral, updated IRIS staging, including systolic blood pressure and UPC, is recommended.

### IN SUMMARY

Nutritional intervention in a cat or dog with CKD can greatly affect morbidity and mortality. Diet selection should be based on a complete nutritional assessment of the patient, including staging the patient's CKD. Supplementation with the omega-3 fatty acids EPA and DHA is recommended if the diet does not provide those nutrients. Patients with a poor or selective appetite may benefit from assisted feeding or consultation with a board-certified veterinary nutritionist for a home-prepared diet formulation. A directory of board-certified veterinary nutritionists is available at [acvn.org/directory](http://acvn.org/directory).



AAFCO = Association of American Feed Control Officials; BCS = body condition score; CKD = chronic kidney disease; DHA = docosahexaenoic acid; DMB = dry matter basis; EPA = eicosapentaenoic acid; IRIS = International Renal Interest Society; NRC = National Research Council; RER = resting energy requirement; UPC = urine protein-to-creatinine ratio

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# CE Test: Nutritional Management of Chronic Kidney Disease in Cats & Dogs

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## Learning Objective

After reading this article, readers should be able to identify the role of key nutritional factors for chronic kidney disease (CKD) patients as well as prepare an appropriate nutritional plan for cats and dogs with CKD based on a complete nutritional assessment.

1. **Based on International Renal Interest Society (IRIS) guidelines, when is nutritional intervention for both dogs and cats recommended?**
  - a. IRIS stage 1
  - b. IRIS stage 2
  - c. IRIS stage 3
  - d. IRIS stage 4
2. **Which omega-3 fatty acid can be supplemented to pet food, but is inefficiently converted to eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in dogs and cats?**
  - a. Linoleic acid
  - b. Docosapentaenoic acid (DPA)
  - c. Alpha-linolenic acid
  - d. Arachidonic acid
3. **What type of studies have been performed in both cats and dogs to provide evidence-based medicine that therapeutic kidney diets improve a patient's quality of life and increase life span?**
  - a. Prospective cohort studies
  - b. Double-blinded, randomized, controlled clinical trials
  - c. Case-control studies
  - d. Adaptive clinical trials
4. **Improvement of anemia may be associated with restriction of which of the following nutrients?**
  - a. Protein
  - b. Phosphorus
  - c. Potassium
  - d. Sodium
5. **Urea is a major uremic toxin in the dog and cat.**
  - a. True
  - b. False
6. **Restriction of which one of the following nutrients has been independently shown to delay the progression of CKD in both dogs and cats?**
  - a. Protein
  - b. Sodium
  - c. Potassium
  - d. Phosphorus
7. **The following uncommon electrolyte disturbance in dogs with CKD has been corrected by feeding a home-prepared diet formulated by a board-certified veterinary nutritionist.**
  - a. Hyperkalemia
  - b. Hypokalemia
  - c. Hypophosphatemia
  - d. Hypernatremia
8. **The protein requirement of dogs and cats is typically evaluated through the use of nitrogen balance studies. What is another method for evaluating the protein requirement?**
  - a. Urine albumin-to-creatinine ratio
  - b. Serial evaluation of serum albumin and creatinine concentration
  - c. Maintenance of lean body mass
  - d. Muscle condition score
9. **Which of the following is a concern regarding feeding a protein restricted diet to a patient with CKD?**
  - a. Feeding below the National Research Council's minimum nutritional requirements for protein
  - b. Production of excess urea and creatinine
  - c. Failure to achieve caloric needs
  - d. Endogenous protein catabolism and loss of lean body mass
10. **Reducing protein intake by 25% to 50% of current intake based on an accurate diet history in a patient with moderate glomerular proteinuria and mild azotemia is a reasonable recommendation.**
  - a. True
  - b. False



### Note:

Questions and answers online may differ from those at right; tests are valid for 2 years from date of approval.