

Nutrient Profile of Renal Specific Formula

SUMMARY

It is well known that nutrient guidelines/recommendations exist for Chronic Kidney Disease (CKD). In fact, the renal diet is considered to be the strictest and most confusing diet for any CKD patient. This article will look closer at what type of ingredients should be considered for, and be contained in, a renal specific enteral formula.



SCIENTIST BIOGRAPHY

Dr. Kelly obtained both his Bachelor of Science (B.Sc.) and Doctor of Philosophy (Ph.D.) in Nutrition from University College Cork, Ireland. As a Postdoctoral Fellow at The Florida State University, Dr. Kelly received an *American Society for Bone and Mineral Research Young Investigator Award* for his work in obesity and bone. Dr. Kelly is also a Registered Nutritionist (RNutr.) through the Association for Nutrition in the UK. Prior to joining Abbott Nutrition, Dr. Kelly worked as an Assistant Professor at Texas Woman's University where he lectured to dietetic and nursing students. Currently a Research Scientist in Abbott Nutrition, he is the lead scientist for renal products. Other responsibilities include: providing support for new clinical trials by assisting in protocol design and supporting ongoing clinical trials by assisting with the interpretation and publication of data. Dr. Kelly provides scientific input for products and claims in new and existing products. Dr. Kelly provides education globally and collaborates with internal and external teams to conceive and execute new product ideas and concepts.

RENAL SPECIFIC ENTERAL FORMULAE ARE BASED ON EXPERT GUIDELINES

The nutrient requirements for CKD patients are well known. Energy and protein requirements are well established, as are the requirements for phosphorus, potassium and sodium, although questions regarding quantities of other macronutrients and micronutrients have yet to be answered. Three major renal nutrition expert groups exist; the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (K/DOQI) ¹, the European Society for Clinical Nutrition and Metabolism (ESPEN) ², and the European Best Practice Guidelines (EBPG) ³. Each group has its own set of guidelines, however there is considerable agreement amongst them, which is a major advantage; Table 1 summarizes the current recommendations for non-dialysed CKD Stage 3-5 and Table 2 shows the recommendations for dialysed CKD Stage 5, also known as End Stage Renal Disease (ESRD).

Table 1: Expert nutritional recommendations for Stage 3-5 CKD patients not on dialysis.

	K/DOQI ¹	ESPEN ²
Energy/Calories	< 60 years: 35 kcal/kg/d ≥ 60 years or obese: 30-35 kcal/kg/d	35 kcal/kg/d
Protein	0.6-0.75 g/kg/day 50% high biological value (HBV)	Glomerular filtration rate (GFR) 25-70 ml/min: 0.55-0.60 g/kg/d (66.6% HBV) GFR < 25 ml/min: 0.55-0.60 g/kg/d (66.6% HBV) or 0.28 g/kg/d + essential amino acids (EAA) or 0.28 g/kg/d + EAA + α-keto acids
Phosphorus	800-1,000 mg/d or < 17 mg/kg ideal or standard body weight/d	600-1,000 mg/d
Potassium	—	1,500-2,000 mg/d
Sodium	—	1.8-2.5 g/d

Table 2: Expert nutritional recommendations for Stage 5 CKD patients on dialysis.

	K/DOQI ¹	ESPEN ²	EBPG ³
Energy	< 60 years: 35 kcal/kg/d ≥ 60 years or obese: 30-35 kcal/kg/d	35 kcal/kg/d	30-40 kcal/kg/d
Protein	1.2 g/kg/d 50% high biological value	1.2-1.4 g/kg ideal body weight/d	1.1 g/kg/d
Sodium	—	1.8-2.5 g/d	2,000-3,000 mg/d
Fluid	—	1,000 ml + urine volume	—
Potassium	—	2,000-2,500 mg/d	1,950-2,730 mg/d
Phosphorus	800-1,000 mg/d or < 17 mg/kg ideal or standard body weight/d	800-1,000 mg/d	800-1,000 mg/d
Calcium	≤ 2,000 mg/d	—	2,000 mg/d

Because of the nutrient requirements and especially because of the mineral restrictions, the renal diet is infamous for its limitations on what foods can be consumed. Furthermore, dialysis patients (ESRD) are recommended to restrict fluids (water, coffee, tea, etc.) which is intricately linked with salt/sodium restrictions⁴. Many CKD patients also have diabetes, and other comorbidities, so diet confusion is elevated as the renal diet can contradict diabetes dietary guidelines as well as general healthy diet guidelines. Therefore, the first criterion for a renal specific formula would be to adhere to expert guidelines.

RENAL SPECIFIC FORMULA SHOULD CONTAIN HIGH BIOLOGICAL VALUE PROTEIN

Protein is possibly the single most important nutrient in relation to CKD. As noted by all three expert groups¹⁻³, at least 50% of the protein in a renal specific formula should be of high biological value. Using the latest protein scoring system recognized by the World Health Organization, the Protein Digestibility Corrected Amino Acid Score (PDCAAS), milk, soy and egg proteins are recognized as having the highest score⁵. In addition, there should be two protein level options/products for CKD patients; a higher level for dialysis patients and a lower level of protein for those not on dialysis. Furthermore, K/DOQI recommends a phosphorus to protein ratio for dialysis patients of < 10 mg/g⁶. This recommendation is difficult as many high biological value proteins are high in phosphorus. Phosphorus is essential for life; it is a component of genetic material, phospholipids in cell membranes, and breaking phosphorus bonds is how



humans make energy. Phosphorus is also required for protein function and regulation, bone structure and blood acid-base balance. The importance of phosphorus is recognized by the expert groups¹⁻³, thus an intake of 800-1,000 mg/d is recommended. Casein, a milk protein contains 0.7-0.9% phosphorus⁷, whey protein, another milk protein, contains 0.1-0.6% phosphorus⁸, and soy contains approximately 0.8% phosphorus⁹.

IN THE ABSENCE OF EVIDENCE TO THE CONTRARY, THE LIPIDS IN A RENAL SPECIFIC FORMULA SHOULD REFLECT CURRENT HEALTHY GUIDELINES

Currently no CKD specific guidelines for either the total lipid intake or the types of lipids exist; therefore, following current dietary guidelines for healthy people is the default option. Globally, healthy guidelines for lipid intake suggest saturated fat should be < 7% of total calories, unsaturated fat should substitute for saturated fat, increase n-3 (omega-3) fatty acid intake and aim for zero trans fatty acids^{10,11}. Therefore, the criteria for the lipid blend used in renal specific formula should follow healthy guidelines and include the n-6 and n-3 essential fatty acids (linoleic acid and alpha-linolenic acid respectively), and have a lower n-6/n-3 ratio, contain monounsaturated fatty acids, be low in saturated fats and have zero trans fatty acids.

IN THE ABSENCE OF EVIDENCE TO THE CONTRARY, THE CARBOHYDRATE IN A RENAL SPECIFIC FORMULA SHOULD REFLECT CURRENT HEALTHY GUIDELINES

Similar to lipids, as no specific recommendations exist for the type or amount of carbohydrate required for CKD, current healthy guidelines are utilized. Healthy guidelines, globally, focus on increasing the intake of complex, or low glycemic index, carbohydrate including whole grain, fruits, vegetables, legumes and nuts; the lower potassium options are preferred for CKD patients. Healthy guidelines also suggest limiting the intake of mono- and di-saccharides (e.g. glucose, fructose and sucrose), and increase the fiber intake. Because many patients with CKD also have diabetes, additional dietary recommendations are required; apart from encouraging low glycemic carbohydrate, artificial sweeteners are acceptable and sugar alcohols should be limited to < 10 mg/d¹². Therefore, the criteria for the carbohydrate blend used in renal specific formula should follow healthy guidelines and include more complex carbohydrate (low glycemic index) and fiber, and minimize mono- and di-saccharides, knowing some sugar is required for taste and texture of the final product, or use artificial or alternative sweeteners while limiting sugar alcohols.

RENAL SPECIFIC FORMULA SHOULD BE LOWER IN PHOSPHORUS, POTASSIUM & SODIUM

Per expert guidelines phosphorus, potassium and sodium intakes are restricted for CKD patients, therefore, the next criterion for renal specific formulae would be to limit these minerals, keeping in mind some patients may require sole source nutrition. Regarding the other minerals and vitamins, in the absence of evidence to the contrary, the dietary reference intakes (DRI) should be followed.

CARNITINE AND TAURINE CAN BE CONDITIONALLY ESSENTIAL NUTRIENTS IN CKD

A good diet will supply carnitine and taurine primarily from animal products; however anorexia (poor food intake) can be common in CKD¹³. Carnitine is synthesized from lysine and methionine in the liver and



kidneys. High concentrations are found in heart and skeletal muscle as it is required for the transportation of long chain fatty acids into mitochondria for energy production. Taurine is synthesized from cysteine in the liver and brain and participates in many physiological functions, including muscle and nerve function, and bile salt production. Taurine has even been used as a substitute for glucose in peritoneal dialysis solutions¹⁴. Therefore, as both carnitine and taurine are made from amino acids, protein-energy wasting (PEW; under nutrition with catabolism and inflammation) may make these compounds conditionally essential so it may be prudent to have these nutrients included in a renal specific product.

RENAL SPECIFIC PRODUCTS ARE OPTIMIZED FOR CKD AND DIABETES

Choosing a renal specific product over a standard or other disease specific nutritional supplement is a better choice for the patient as it follows expert guidelines and opinion. The following table summarizes the key differences between a standard oral nutritional supplement (ONS) and a renal specific ONS.

Component	Standard ONS	Renal specific ONS
Protein	Not optimized for CKD stages	Higher protein for dialysis Lower protein for nondialysed
Glycemic index	Higher	Lower for diabetes
Monounsaturated fatty acids	Lower	Higher
Phosphorus, potassium, sodium and calcium	Higher	Lower
Fluid volume	Higher	Lower
Caloric density	Lower	Higher
Fiber	Lower	Higher

THE RENAL SPECIFIC ONS YOU PRESCRIBE SHOULD HAVE GOOD CLINICAL EVIDENCE

The renal specific product you recommend to your patients should have clinical evidence to show it:

- Is well tolerated and safe
- Fills the kcal and protein intake gaps
- Increases or maintains body weight
- Improves serum albumin, serum prealbumin levels



- Improves nutritional status (subjective global assessment/malnutrition inflammation score)
- Has a minimal impact on serum phosphorus
- Is associated with lower mortality
- Is associated with improved quality of life

KEY MESSAGES

- Renal specific ONS that adhere to expert guidelines are available
- Can be used in conjunction with food (supplement) or as sole source (enteral feeding)
- Fill the nutrient gaps or temporary sole source feeding
- Can be used to treat or prevent protein energy wasting (PEW)
 - International Society of Renal Nutrition & Metabolism PEW algorithm ¹³
 - Protein restriction algorithm ¹⁵
- Renal specific ONS are supported by clinical evidence showing efficacy for CKD specific outcomes

CONCLUSION

In a patient population prone to PEW, renal specific ONS offers an efficacious, nutrient dense alternative, with known specifications, to assist medical professionals optimize nutritional strategies and improve clinical outcomes within the complex etiology of PEW.

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