Are High-Protein, Vegetable-Based Diets Safe for Kidney Function? A Review of the Literature

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ABSTRACT
In individuals with chronic kidney disease, high-protein diets have been shown to accelerate renal deterioration, whereas low-protein diets increase the risk of protein malnutrition. Vegetarian diets have been promoted as a way to halt progression of kidney disease while maintaining adequate nutrition. We review the literature to date comparing the effects of animal and vegetable protein on kidney function in health and disease. Diets with conventional amounts of protein, as well as high-protein diets, are reviewed. The literature shows that in short-term clinical trials, animal protein causes dynamic effects on renal function, whereas egg white, dairy, and soy do not. These differences are seen both in diets with conventional amounts of protein and those with high amounts of protein. The long-term effects of animal protein on normal kidney function are not known. Although data on persons with chronic kidney disease are limited, it appears that high intake of animal and vegetable proteins accelerates the underlying disease process not only in physiologic studies but also in short-term interventional trials. The long-term effects of high protein intake on chronic kidney disease are still poorly understood. Several mechanisms have been suggested to explain the different effects of animal and vegetable proteins on normal kidney function, including differences in postprandial circulating hormones, sites of protein metabolism, and interaction with accompanying micronutrients.


More than 60% of adults in the United States aged 20 to 74 years are overweight or obese (1) and a similar percentage of the population is reported to be dieting at any one time (2). Popular weight-loss diets today encourage increasing protein intake and decreasing carbohydrate intake to promote fat breakdown and decrease total energy intake (3,4). The protein in these diets may range from 71 g to 162 g per day (5), far in excess of the Dietary Reference Intake, which suggests 0.8 g protein/kg/day/person, or 56 g protein/day for a 70 kg healthy male adult and 46 g protein/day for a 65 kg healthy female adult (6). The protein content of these high-protein diets even exceeds the amount of protein in the typical American diet, which is approximately 1.2 g protein/kg/day (Table 1) (7).

High-protein diets pose particular problems for patients with chronic kidney disease (CKD) because high protein intake may accelerate CKD (8). At the same time, and equally concerning, patients with CKD are at high risk for protein malnutrition due to decreased protein intake, uremia, depression, illness-induced hypercatabolism, acidemia-induced muscle breakdown, and, when applicable, dialysis (9-11). To halt progression of CKD while preventing protein malnutrition, the National Kidney Foundation (NKF) recommends a diet of 0.6 g protein/kg/day for patients with advanced CKD (glomerular filtration rate 25 mL/min/1.73 m² [0.41 mL/s/1.73 m²]) and 1.2 g protein/kg/day for patients with end-stage renal disease (glomerular filtration rate <10 mL/min/1.73 m² [0.16 mL/s/1.73 m²]), allowing for increased protein loss from dialysis (12,13). There are no clear guidelines for patients with mild to moderate kidney disease.

Recently, investigators observed different effects between animal and vegetable proteins on renal function (Table 2) (14-27). Some, but not all, studies suggest that diets high in vegetable protein do not accelerate CKD in the same way that animal proteins do. Animal models of CKD suggest vegetarian diets are nutritionally adequate (28-32). These observations are meaningful because they suggest that diets high in vegetable protein may permit
safe weight loss in overweight or obese patients with CKD. Furthermore, such diets may represent an alternative for patients with CKD who are unable to follow the traditional NKF low-protein diet.

We reviewed the literature to date examining differences between animal and vegetable protein and kidney function. We examined both conventional and high-protein diets in normal renal function and CKD. Animal protein sources include red meat, white meat, fish, dairy, and eggs; for the purpose of this article, vegetable proteins include soy and wheat gluten. We considered a high-protein diet one that includes protein in excess of the Dietary Reference Intake recommendation for a person with kidney disease. For example, the Dietary Reference Intake recommendation for a person with kidney disease not undergoing dialysis (ie, 0.6 g/kg/day) is lower than the typical NKF recommendation for a person with kidney disease not undergoing dialysis (ie, 0.6 g/kg/day).

Kidney function is described primarily in terms of glomerular filtration rate, recognized in the executive summary of the NKF Disease Outcome Quality Initiative as the best overall measure of kidney function (33). When glomerular filtration rate is not measured, we report on creatinine clearance, which is an alternative, though imperfect, measure of glomerular filtration, because creatinine is both filtered and secreted in the kidneys. Where appropriate, we also report renal vascular resistance, renal plasma flow, and protein excretion, which offer additional measurements of glomerular perfusion and injury. Of note, normal kidney function is regarded as a glomerular filtration rate ≥89 mL/min/1.73 m². A lower glomerular filtration rate indicates kidney disease. For persons with a low glomerular filtration rate, a further decrease in glomerular filtration rate indicates progression toward end-stage renal disease, while a rise in glomerular filtration rate indicates an improvement in kidney function.

**EFFECTS OF DIETARY ANIMAL AND VEGETABLE PROTEIN ON NORMAL RENAL FUNCTION**

**Single-Meal Studies**

Early studies of the renal hemodynamic response to a one-time high–animal-protein meal showed an acute rise in renal plasma flow, glomerular filtration rate, and proteinuria (18,23,34,35). These meals, however, were often composed of several different types of animal protein (including red meat and dairy) or did not specifically identify the type of meat. Later studies looked at meals composed of protein from one specific source (25,26). Nakamura and colleagues (27) showed that in subjects with normal renal function, the glomerular filtration rate rose significantly after ingestion of tuna fish, although there was no significant difference in glomerular filtration rate after ingestion of egg white, in the amount of either 0.7 g protein per kilogram body weight or 1.4 g protein per kilogram body weight. The glomerular filtration rate of patients with diabetes after ingestion of each of the meals was similar to that in healthy volunteers. In a separate study, Nakamura and colleagues (26) showed no significant difference in glomerular filtration rate after ingestion of cheese and soy, suggesting their effect on renal hemodynamics is similar to that of egg white.

**Clinical Trials**

Short-term clinical trials show similar results to single-meal physiologic studies. Kontessis and colleagues (24) placed patients with normal renal function on either a 1.1 g/kg/day high–animal-protein diet or a 0.95 g/kg/day high–vegetable-protein diet for 4 weeks and found that those on the animal-protein diet had higher glomerular filtration rate and albuminuria compared to those receiving the vegetable protein. In a separate study, they randomized patients to 3 weeks of a high-protein diet (1 g/kg/day) of either soy, animal protein (types of protein not described), or animal protein diet supplemented with fiber. They reported that those on the animal protein diet had significantly higher renal plasma flow, glomerular filtration rate, and proteinuria compared to those consuming the soy diet, and that fiber did not significantly effect these outcomes (23). Jibani and colleagues (21) reported that an 8-week prospective study of persons with type 1 diabetes, who when switched from a mixed animal–vegetable-protein diet (vegetable protein 0.3 g/kg) to a diet higher in vegetable protein (vegetable protein 0.7g/kg), showed no change in glomerular filtration rate but did demonstrate a decrease in albuminuria by 50%. However, total protein intake before intervention was 1.3 g/kg and during intervention was 1.0 g/kg. In a retrospective analysis of 1,150 patients with diabetes, Mollsten and colleagues (36) similarly showed that high

### Table 1. Recommended protein intake for a 70 kg male (based on an average 2,000 kcal/day diet; 1 g protein=4 kcal)

<table>
<thead>
<tr>
<th>Diet type</th>
<th>Protein as % of daily energy intake</th>
<th>Protein g/kg/d</th>
<th>Total protein g/day</th>
<th>Main source of protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Dietary Reference Intake (6)</td>
<td>11</td>
<td>0.8</td>
<td>56</td>
<td>Complete proteins composed of animal and/or vegetable proteins</td>
</tr>
<tr>
<td>National Kidney Foundation (advanced kidney disease without dialysis) (8)</td>
<td>8</td>
<td>0.6</td>
<td>42</td>
<td>50% should be of high biological value</td>
</tr>
<tr>
<td>National Kidney Foundation (for end-stage renal disease) (9)</td>
<td>16</td>
<td>1.2</td>
<td>84</td>
<td>50% should be of high biological value</td>
</tr>
<tr>
<td>High protein diet: Atkins (7)</td>
<td>27</td>
<td>1.9</td>
<td>135</td>
<td>Meat, fish, eggs, cheese</td>
</tr>
<tr>
<td>High protein diet: South Beach (7)</td>
<td>23</td>
<td>1.6</td>
<td>115</td>
<td>Lean meat, fish, eggs, cheese, nuts</td>
</tr>
<tr>
<td>Average American (7)</td>
<td>16</td>
<td>1.2</td>
<td>84</td>
<td>Mixed protein sources; typically nonlean meats</td>
</tr>
</tbody>
</table>
fish intake protected against development of microalbuminuria. Differences between red meat and white meat were examined in one study of persons with diabetes with normal renal function who replaced their red meat diet with a chicken-based diet and found that after 4 weeks there was a decrease rather than increase in glomerular filtration rate (19). Collectively, these studies suggest that high intakes of red meat, but perhaps not white meat or fish or vegetables, increase glomerular filtration rate and proteinuria in persons with normal renal function.

Despite evidence suggesting that vegetable protein, dairy, and egg white do not affect normal renal function acutely or over several weeks, data are mixed regarding whether or not there is a threshold beyond which increasing amounts of these proteins may alter normal renal function. Jenkins and colleagues (20) reported a 1-month randomized cross-over study of 20 patients with normal renal function and showed that those on a diet high in vegetable protein (139 g gluten/day), when compared to those on a lower–vegetable-protein diet (59 g gluten/day), had increased blood urea as well as lower levels of oxidized low-density lipoprotein cholesterol, but no significant difference in creatinine clearance. By contrast, a 4-month retrospective study by Brandle and colleagues (17) of 88 subjects with normal renal function consuming protein ranging from 0.29 g/kg/day (17 g/day) to 2.6 g/kg/day (212 g/day) showed a positive, nonlinear relationship between protein intake and creatinine clearance. This relationship was seen in subjects eating vegan and lacto-vegetarian diets and those eating mixed animal–vegeta-

<table>
<thead>
<tr>
<th>Study and year</th>
<th>Reference no.</th>
<th>Protein type</th>
<th>Study design</th>
<th>Baseline kidney function</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson and colleagues, 1998</td>
<td>14</td>
<td>A, V</td>
<td>8-wk trial</td>
<td>CKD&lt;sup&gt;a&lt;/sup&gt;</td>
<td>HP&lt;sup&gt;b&lt;/sup&gt; A, V diets: decrease in GFR&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Barsotti and colleagues, 1991</td>
<td>15</td>
<td>V (vegan)</td>
<td>1- to 7-mo trial</td>
<td>CKD</td>
<td>No change in CrCl&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Barsotti and colleagues, 1996</td>
<td>16</td>
<td>V (vegan)</td>
<td>4- to 6-mo trial</td>
<td>CKD</td>
<td>Decrease in GFR</td>
</tr>
<tr>
<td>Brandle and colleagues, 1996</td>
<td>17</td>
<td>A, V</td>
<td>4-mo trial</td>
<td>N&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Linear relation between both A and V protein intake and CrCl</td>
</tr>
<tr>
<td>Chan and colleagues, 1988</td>
<td>18</td>
<td>A</td>
<td>Single meal</td>
<td>N, CKD</td>
<td>N, CKD: Acute rise in GFR, RPF&lt;sup&gt;f&lt;/sup&gt;, proteinuria</td>
</tr>
<tr>
<td>Gross and colleagues, 2002</td>
<td>19</td>
<td>A</td>
<td>4-wk trial</td>
<td>N</td>
<td>Red meat replaced with chicken led to decrease in GFR</td>
</tr>
<tr>
<td>Jenkins and colleagues, 2001</td>
<td>20</td>
<td>V</td>
<td>4-wk trial</td>
<td>N</td>
<td>HP diet: no change in creatinine clearance compared to NP&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>Jibani and colleagues, 2001</td>
<td>21</td>
<td>V</td>
<td>8-wk trial</td>
<td>N (diabetic)</td>
<td>Decrease in albuminuria</td>
</tr>
<tr>
<td>Knight and colleagues, 2003</td>
<td>22</td>
<td>A, V</td>
<td>11 y</td>
<td>N, CKD</td>
<td>N: no relation between protein and GFR; CKD: HP non-dairy A protein greater decrease in GFR than dairy, V protein diet</td>
</tr>
<tr>
<td>Kontessis and colleagues, 1990</td>
<td>23</td>
<td>A, V</td>
<td>Single meal and 3-wk trial</td>
<td>N</td>
<td>Single meal: acute rise in GFR, RPF, proteinuria; 3 wk trial: A protein with greater RPF, GFR, proteinuria compared to protein</td>
</tr>
<tr>
<td>Kontessis and colleagues, 1995</td>
<td>24</td>
<td>A, V</td>
<td>4-wk trial</td>
<td>N</td>
<td>HP A: greater rise in GFR, albuminuria than HP V</td>
</tr>
<tr>
<td>Nakamura and colleagues, 1991</td>
<td>26</td>
<td>A, V</td>
<td>Single meal</td>
<td>N</td>
<td>Tuna: increase in GFR; cheese, tofu, egg white: no change</td>
</tr>
<tr>
<td>Nakamura and colleagues, 1993</td>
<td>27</td>
<td>A, V</td>
<td>Single meal</td>
<td>N (diabetic)</td>
<td>tuna: rise in GFR; egg-white: no change</td>
</tr>
<tr>
<td>Bergstrom and colleagues, 1985</td>
<td>34</td>
<td>A</td>
<td>Single meal</td>
<td>N</td>
<td>acute rise in GFR, RPF, proteinuria</td>
</tr>
<tr>
<td>Viberti and colleagues, 1987</td>
<td>35</td>
<td>A</td>
<td>Single meal</td>
<td>N (diabetic)</td>
<td>Acute rise in GFR, RPF, proteinuria</td>
</tr>
<tr>
<td>Mollsten and colleagues, 2001</td>
<td>36</td>
<td>A</td>
<td>Case-control</td>
<td>N (diabetic)</td>
<td>Fish intake lowered odds for development of microalbuminuria</td>
</tr>
</tbody>
</table>

<sup>a</sup>CCKD—chronic kidney disease.  
<sup>b</sup>HP—high-protein diet.  
<sup>c</sup>GFR—glomerular filtration rate.  
<sup>d</sup>CrCl—creatinine clearance.  
<sup>e</sup>N—normal kidney function.  
<sup>f</sup>RPF—renal plasma flow.  
<sup>g</sup>NP—normal protein diet (equal or less than US Recommended Dietary Intake).
ble protein diets. Creatinine clearance reached a plateau at 181 mL/min/1.73 m², (3.02 mL/s/1.73 m²), which corresponded to an intake of 125 g protein/day, whereas further increases in protein intake had little influence on creatinine clearance. The Nurses Health Study followed the dietary habits of 1,624 women with normal or mild renal insufficiency across 11 years. Animal and vegetable protein intake ranged from 60 g to 93 g protein/day. The study found no significant association between protein intake and change in glomerular filtration rate in women with normal renal function, and a subanalysis of animal protein, dairy protein, and vegetable protein showed that none of the individual sources of protein were associated with a change in glomerular filtration rate in women with normal renal function (22). From these studies, it is difficult to conclude whether or not there is a long-term association between amount of animal or vegetable protein intake and change in normal renal function. This inconclusiveness may be attributed to methodological differences among studies, including study duration, range of protein intake, and heterogeneity of protein source.

**EFFECTS OF DIETARY ANIMAL AND VEGETABLE PROTEIN ON CKD**

**Single-Meal Studies**

Patients with CKD respond to varying amounts of animal and vegetable protein differently than those with normal renal function. This difference is observed in both single-meal studies and in clinical trials. In Nakamura and colleagues' study (25) of patients eating a high-protein load of tuna fish (1 g/kg), within 3 hours in patients with diabetes and macroalbuminuria, glomerular filtration rate decreased, rather than increased, as it did with normal subjects. Glomerular filtration rate did not change after eating soy. Yet in Chan and colleagues' study (18) of patients with nondiabetic nephropathy, within 3 hours of eating 1.5 g/kg meal of steak, eggs, and milk, renal plasma flow and glomerular filtration rate increased. Although these physiologic studies suggest that fish protein influences CKD hemodynamics differently than other animal proteins, and that diabetic and nondiabetic CKD respond differently to dietary animal protein, there is insufficient evidence at this point to arrive at substantiated conclusions.

**Clinical Trials**

Longer duration studies of CKD have not borne out the differences observed in single-meal studies. Anderson and colleagues (14) reported an 8-week randomized crossover study of eight people with diabetes with proteinuria and moderate renal insufficiency. A decrease in glomerular filtration rate was observed both in patients receiving a 1 g/kg animal protein diet and in patients receiving a 1 g/kg soy protein diet, suggesting that there is no advantage to soy-protein–based diet in diabetic CKD. Barsotti and colleagues (15) followed patients with nondiabetic nephropathy and moderate to severe renal insufficiency on a vegan protein diet at 0.7 g/kg/day for 3 months. Compared to a conventional animal-based low-protein diet (0.6 g/kg body weight), the patients receiving the vegan diet did not have significantly lower creatinine clearance. In a separate study, Barsotti and colleagues (16) followed 20 patients with nondiabetic nephrosis transitioned from a mixed animal–vegetable diet (1.0 to 1.3 g/kg/day) to a vegan diet (0.7 g/kg/day). After an average of 4 to 6 months, the patients showed significant decrease in glomerular filtration rate and proteinuria; however, in this study the total protein intake was simultaneously decreased, making it difficult to understand the etiology for these changes. The Nurses Health Study followed patients with normal kidney function and mild renal insufficiency (22). In the mild renal insufficiency group, an increase in protein intake correlated with a decrease in glomerular filtration rate. Women consuming high-protein diets (average 93 g protein/day) had a 4.77 mL/min/1.73 m² (0.08 mL/s/1.73 m²) lower glomerular filtration rate than those consuming conventional-protein diets (average 60 g protein/day). Subanalysis revealed the consumption of nondairy animal protein led to greater decreases in glomerular filtration rate than either dairy or vegetable protein; however, high intakes of each had deleterious effects.

These studies suggest that a predominantly or exclusively vegetable-based protein diet may not protect against progression of CKD and that high protein intake, from either vegetable or animal source, may accelerate CKD.

**NUTRITIONAL ADEQUACY OF VEGETABLE PROTEIN-BASED DIETS IN CKD**

Protein-energy malnutrition is common among patients with CKD and particularly in those undergoing dialysis. Reports suggest that the prevalence of this condition varies from roughly 18% to 70% of adult maintenance dialysis patients (11). In adults, the presence of such malnutrition is one of the strongest predictors of morbidity and mortality (11).

Vegetarian diets have been studied as means to halt progression of CKD while maintaining adequate protein nutrition. In mouse models of polycystic kidney disease, soy, when compared to the milk protein casein, retards cyst formation, renal enlargement, macrophage infiltration, and fibrosis without significantly affecting body weight, serum total protein, or serum albumin (28-31). In Zucker rats with obesity-related nephropathy, a soy diet, again when compared to casein, improved renal function, proteinuria, glomerulosclerosis, and interstitial fibrosis and at the same time led to weight gain (32).

There are limited studies in human beings examining the nutritional adequacy of vegetarian diets in persons with CKD. In Jibani and colleagues' study (21) of patients with diabetes with proteinuria placed on a predominantly vegetable protein diet (0.7 g/kg) for 8 weeks, there was a significant increase in midarm muscle circumference, but no significant difference in body weight or triceps skinfold thickness, even as the patients consumed less total protein per day than before the study (1.4 g/kg/day vs 1.0 g/kg/day). D’Amico and colleagues’ (37) 8-week study of patients with nephrotic syndrome receiving a vegetable protein diet (0.7 g/kg) showed a decrease in body weight but no significant change in serum albumin and transferrin (37). Similarly, Barsotti (16) saw no significant change in serum total protein or albumin in patients with diabetes transitioned from a traditional 1.0 to 1.3 g pro-
tein/kg/day diet to a 0.7 g protein/kg/day vegan diet. These studies suggest that soy-based diets may provide nutritional adequacy to persons with CKD.

MECHANISTIC MODELS TO EXPLAIN DIFFERENT EFFECTS OF ANIMAL AND VEGETABLE PROTEIN ON RENAL FUNCTION

Hostetter and Brenner’s (38) hyperfiltration theory proposed that protein consumption acutely increases renal plasma flow and glomerular filtration, leading to glomerular hyperfiltration and hypertension, which over time leads to chronic glomerular injury, fibrosis, and mesangial cell proliferation (38). Glucagon (23), vasopressin, renin, angiotensin (18), prostaglandins (23), and insulin (4) are regulators of this process. How dietary protein influences these mediators remains unclear.

There are several important features in the composition of animal and vegetable proteins that may explain their different effects on normal kidney function (Table 3). Their different amino acid composition (25), or the relative proportions of each, may be important. Wheat and egg white both have a relatively small amount of lysine compared to other proteins, but also of alanine, which has been identified as a renal vasodilator (27). The different sites of metabolism may also be relevant as amino acids metabolized in the splanchic region appear to have greater renal effects than those metabolized peripherally (39-41).

Cholesterol metabolism may also play a significant role. Soy consumption lowers low-density lipoprotein cholesterol levels, though the reduction may be only a few percent, and the quantity of daily soy intake needed to achieve such a reduction may be >50 g (42,43). Wheat gluten similarly decreases levels of oxidized low-density lipoprotein cholesterol particles and triglycerides (20). By decreasing these serum lipid levels, vegetable proteins may slow oxidized-lipoprotein induced glomerular damage and progression to the nephrotic syndrome (44). The lipid-lowering effect of the fatty acids found with fish protein may account for similar effects.

Soy isoflavones and wheat phenolics may affect normal renal function through other pathways, including blocking activation of the transforming growth factor-β signals (45,46), protecting low-density lipoprotein cholesterol particles from oxidation (20,44), upregulating nitric oxide generation (47), inhibiting cell growth and proliferation via tyrosine protein kinases (48), inhibiting angiogenesis (48), and suppressing platelet activating factor and platelet aggregation (48). Soy also contains less bioavailable iron and phosphorous, and milk less iron, when compared to red and white meat. The smaller amounts of these minerals may protect normal kidney function, especially in those at risk, such as persons with diabetes (49).

Why it is that animal and vegetable proteins have different effects in a healthy kidney but similar effects in CKD is unclear. It may be that the fibrosis and scarring often present in a diseased kidney do not permit the hemodynamic changes and remodeling that take place in a healthy kidney. It may also be that the comorbidities often seen in CKD, including the anemia, metabolic derangements, and cardiovascular changes, do not permit the same response as in a healthy kidney. Further investigations are needed.

CONCLUSIONS

There are limited studies to date comparing the different effects of animal vs vegetable protein on kidney function. However, this review reveals several important early findings.

- In people with normal renal function, there are dynamic changes in renal function following consumption of a single meal high in animal protein but not after vegetable protein, dairy proteins, or egg white.
- Substitution of vegetable protein or fish protein for animal protein may protect against the development of proteinuria in patients with diabetes.
- Long-term consumption of high-protein diets, composed of either predominantly animal or vegetable protein, by persons with normal renal function may cause renal injury.

Table 3. Comparison of select animal and vegetable proteins from studies of chronic kidney disease

<table>
<thead>
<tr>
<th>Source</th>
<th>Serving size (g)</th>
<th>Total protein (g)</th>
<th>Lysine content (mg/g total nitrogen)</th>
<th>Alanine content (mg/g total nitrogen)</th>
<th>Iron content (mg)</th>
<th>Phosphorous content (mg)</th>
<th>Isoflavone content (mg/100 g protein)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef (lean)</td>
<td>85 (3 oz)</td>
<td>22.04</td>
<td>570</td>
<td>400</td>
<td>2.21</td>
<td>168</td>
<td>1.86</td>
</tr>
<tr>
<td>Chicken, light meat</td>
<td>84 (3 oz)</td>
<td>27.57</td>
<td>581</td>
<td>340</td>
<td>0.96</td>
<td>194</td>
<td>NA</td>
</tr>
<tr>
<td>Tuna, fresh</td>
<td>85 (3 oz)</td>
<td>25.47</td>
<td>555</td>
<td>287</td>
<td>0.8</td>
<td>208</td>
<td>NA</td>
</tr>
<tr>
<td>Milk, nonfat</td>
<td>244 (1 c)</td>
<td>8.26</td>
<td>559</td>
<td>NA</td>
<td>0.07</td>
<td>247</td>
<td>NA</td>
</tr>
<tr>
<td>Egg white</td>
<td>33 (1 large egg)</td>
<td>3.64</td>
<td>420</td>
<td>288</td>
<td>0.03</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>Soybeans (mature)</td>
<td>172 (1 c)</td>
<td>28.62</td>
<td>531</td>
<td>278</td>
<td>8.84</td>
<td>471</td>
<td>128.53</td>
</tr>
<tr>
<td>Whole-wheat flour</td>
<td>120 (1 c)</td>
<td>16.44</td>
<td>194</td>
<td>194</td>
<td>4.66</td>
<td>415</td>
<td>NA</td>
</tr>
</tbody>
</table>

● Soy beans (mature) 172 (1 c) 28.62 531 278 8.84 471 128.53
● Egg white 33 (1 large egg) 3.64 420 288 0.03 5 NA
● Beef (lean) 85 (3 oz) 22.04 570 400 2.21 168 1.86


*US Dept of Health, Education, and Welfare and FAO Food, Policy, and Nutrition Division. Food composition table for use in East Asia 1972, Part II, Section A, FAO corporate document repository. Available at: http://www.fao.org/docrep/003/x6870e/x6870e00.htm#toc. Accessed August 3, 2006. (Beef is fresh; chicken is raw; tuna is yellowtail; soybeans are immature; wheat is whole grain; alanine content of milk unavailable.)


*NA—Not available.
• High protein intake, from either vegetable or animal source, likely accelerates CKD.
• Vegetable protein diets appear to meet protein requirements and provide adequate nutrition in people with CKD.

Future studies should continue to explore differences between animal and vegetable protein on renal function. Areas for investigation may include the long-term effects of exclusively vegetarian diets in patients with overweight or obesity and CKD, studies in human beings of the adequacy of vegetable protein diets for people with CKD, differences in response of diabetic vs nondiabetic kidney disease to proteins of varying source, and the role of micronutrients in explaining the effect of protein on kidney function.

References


