Plant-Based Diets in Dialysis

by

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Introduction

Possible Benefits of Plant-Based Diets in Dialysis
  - Phosphorus
  - Fiber
    - Mortality
    - Uremic Toxins
    - Constipation

Common Concerns with Plant-Based Diets in Dialysis
  - Potassium
  - Protein

Conclusion

*Studies in dialysis are limited; relevant CKD studies may be mentioned*
Hyperphosphatemia
Hyperphosphatemia

- Phosphate levels rise in advanced kidney disease
- Hyperphosphatemia is an independent risk factor for mortality in CKD and dialysis patients
- Phosphate restriction recommended in patients with CKD
  - Although adherence is difficult
  - Phosphate content not disclosed on nutrition labels!

Dietary Sources of Phosphate

- Plant-based proteins actually have more phosphorus than animal-based proteins
  - However, plant-based phosphate is mostly bound as phytates
    - Phytates are the storage form of phosphorus in plants
    - Phosphorus in phytate form is not absorbable because humans lack the enzyme phytase
### “Rule of Thirds”

<table>
<thead>
<tr>
<th>Source</th>
<th>Serving</th>
<th>Phosphorus, mg</th>
<th>Phosphorus-Protein Ratio, mg/g</th>
<th>Gastrointestinal Absorption, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal protein</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk, skim</td>
<td>8 ounces</td>
<td>247</td>
<td>29</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Yogurt, plain nonfat</td>
<td>8 ounces</td>
<td>385</td>
<td>27</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Cheese, mozzarella, part skim</td>
<td>1 ounces</td>
<td>131</td>
<td>20</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Egg</td>
<td>1 large</td>
<td>86</td>
<td>14</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Beef (cooked)</td>
<td>3 ounces*</td>
<td>173</td>
<td>7</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Chicken</td>
<td>3 ounces</td>
<td>155</td>
<td>8</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Turkey</td>
<td>3 ounces</td>
<td>173</td>
<td>8</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Fish, halibut</td>
<td>3 ounces</td>
<td>242</td>
<td>9.3</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Fish, salmon</td>
<td>3 ounces</td>
<td>282</td>
<td>13.4</td>
<td>40 to 60</td>
</tr>
<tr>
<td>Vegetarian protein†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bread, whole wheat</td>
<td>1 slice</td>
<td>57</td>
<td>Varies</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Bread, enriched white</td>
<td>1 slice</td>
<td>25</td>
<td>Varies</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Almonds</td>
<td>12 ounces</td>
<td>134</td>
<td>23</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Peanuts</td>
<td>1 ounce</td>
<td>107</td>
<td>15</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Lentils (cooked)</td>
<td>Half a cup</td>
<td>178</td>
<td>20</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Chocolate</td>
<td>1.4 ounces</td>
<td>142 to 216</td>
<td>27</td>
<td>10 to 30</td>
</tr>
<tr>
<td>Inorganic (additives and preservatives)‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbonated cola drink</td>
<td>12 ounces</td>
<td>40</td>
<td>Not Applicable</td>
<td>80 to 100</td>
</tr>
</tbody>
</table>

* A 3-ounce serving is about the size of a deck of cards.
† Phytate leads to less absorbability.
‡ Inorganic phosphorus may comprise 50% or more of daily dietary phosphorus load.

Improved Phosphate Control with Plant-Based Diets in Humans

- Human study of 8 patients with III/IV CKD
- Cross-over study lasting one week
- Compared vegetarian and meat diets with equivalent phosphate content
- Those on vegetarian diet had lower plasma phosphorus

Caveat to Phosphate Bioavailability from Plants

- Although humans lack phytase (which digests phytate)...
- Phytate can be broken loose with industrial processing (> 140 °C)\(^1\)
  - Processed foods
  - Baked bread
- Not all plant foods are created equally
- Phytate cannot be broken down by home cooking (up to 100 °C)

Serum Phosphate Levels in Dialysis

- Cross-sectional study of dialysis patients
- 19 vegetarian and 299 non-veg
- Serum phosphate levels were significantly lower in those who were vegetarian

**Table 5** Electrolyte and parathyroid hormone of non-vegetarian (non-Veg) and vegetarian (Veg) haemodialysis patients

<table>
<thead>
<tr>
<th></th>
<th>Non-Veg</th>
<th>Veg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K (mEq/L)</td>
<td>4.8 ± 0.12</td>
<td>5.0 ± 0.2</td>
</tr>
<tr>
<td>Ca (mg/dL)</td>
<td>10.7 ± 1.0</td>
<td>9.1 ± 0.3</td>
</tr>
<tr>
<td>P (mg/dL)*</td>
<td>4.8 ± 0.1</td>
<td>4.1 ± 0.2</td>
</tr>
<tr>
<td>iPTH (pg/mL)**</td>
<td>239.2 ± 32.1</td>
<td>111.0 ± 25.9</td>
</tr>
<tr>
<td>Alkaline phosphatase (IU/L)</td>
<td>117.5 ± 6.9</td>
<td>105.2 ± 8.8</td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01. iPTH, intact parathyroid hormone.
Fiber
Mortality, Uremic Toxins, and Constipation
Mortality
Mortality in Kidney Disease

- Kidney disease is extremely deadly
- Those with kidney disease are 16 to 40 times more likely to die than to progress to kidney failure\(^1\)
- Those with kidney failure don’t fare any better
  - 5-year survival rate is 42\%\(^2\)
    - This is worse than early stage lung cancer

\(^1\) https://report.nih.gov/nihfactsheets/ViewFactSheet.aspx?csid=34
\(^2\) https://www.usrd.org/2018/view/v2_05.aspx
For those with kidney failure who wait for a transplant...death comes sooner

- A transplant can’t come soon enough.
- Only 42% of patients with kidney failure on dialysis are alive after five years (on average)
- By comparison, the five-year survival rate for localized lung cancer is 56%

Source: USRDS; www.usrds.org
Plant-Based Diets in CKD & Mortality

- Meta-Analysis of 6 prospective cohort studies including nearly 14,000 adults with CKD
- Eating a healthy dietary pattern associated with a lower risk of mortality (adjusted relative risk 0.73, 95% CI 0.63-0.83)
- More fruits, vegetables, fish, legumes, cereals, whole grains, fiber AND less red meat, salt, and refined sugars
**Fruits and Vegetables in ESRD & Mortality**

- Prospective study from DIET-HD cohort involving 11 countries in Europe and South America
- Approx. 8,000 people followed for a median of 2.7 years
- Fruit and Vegetable (F+V) intake and mortality were measured
- Median number of servings was 8 per week
- Only 4% consumed 4 servings per day (the recommended minimum)
- Compared with the lowest tertile of servings per week, those in the highest tertile were associated with a lower risk of all-cause mortality (HR 0.80, 95% CI 0.71 - 0.91) and non-CV mortality (HR 0.77, 95% CI 0.66 - 0.91)
Fiber Associated with Reduced MACE in Dialysis

- Prospective study with 4 years follow-up
- 219 patients on dialysis in Hong Kong
- Every 1 g/day higher fiber intake was associated with a 11% lower risk of MACE
- Also lower markers of inflammation and lower ventricular hypertrophy

Fiber Associated with Reduced Mortality in Peritoneal Dialysis

A long-term (12 year) prospective cohort study of patients on peritoneal dialysis (n = 881)

Independent association between fiber intake and all-cause mortality

Each 1 gram per day increase in fiber intake correlated with a 13% reduction in all-cause mortality

Fiber Reduces Traditional CVD Risk Factors in Dialysis

- 128 patients on maintenance hemodialysis
- Dietary fiber level was independently correlated with advanced glycation end products ($r^2 = 0.164, P = 0.017$) and C-reactive protein levels ($r^2 = 0.238, P = 0.01$)
- Increased dietary fiber was also associated with less arterial stiffness (as measured by pulse wave velocity)

Fiber Reduces Traditional CVD Risk Factors in Dialysis

- 124 hemodialysis patients randomized to either 10 g/d, 20 g/d of fiber or placebo for 6 weeks
- Compared to placebo, fiber supplemented patients had lower
  - Total Cholesterol
  - LDL Cholesterol
  - Inflammatory makers (TNF-\(\alpha\), IL-6, IL-8 and CRP)

Polyphenol-Rich Interventions Reduced CVD Risk Factors

- Polyphenols are only found in plants
- Systematic review and meta-analysis of 12 studies
- Polyphenol-rich interventions improved
  - Diastolic blood pressure
  - Triglycerides
  - Myeloperoxidase (marker of oxidative stress)

Uremic Toxins
**Fiber in Kidney Failure**

- Dietary fiber was used as a treatment for kidney failure 30 years ago because it reduced blood levels of nitrogenous waste (urea)^1

- Fiber intake has been associated with reduced mortality and cardiovascular disease in CKD^2,^3

- In one study, every extra 1 gram of fiber was associated with an 11% reduction in cardiovascular events^3^

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^1 Rose et al. *Uro & Nephron.* 2019; 6(3): 555687

Image: Reference 2
Uremic Toxins Reduced in Vegetarian Diets

The Production of p-Cresol Sulfate and Indoxyl Sulfate in Vegetarians Versus Omnivores

Kajal P. Patel,† Frank J.-G. Luo,§ Natalie S. Plummer,† Thomas H. Hostetter,† and Timothy W. Meyer†

Summary

Background and objectives The uromic solutes p-cresol sulfate (PCS) and indoxyl sulfate (IS) are generated by colon bacteria acting on food components that escape absorption in the small bowel. The production of these potentially toxic compounds may thus be influenced by diet. This study examined whether production of PCS and IS is different in vegetarians and omnivores.

Design, setting, participants, & measurements The production of PCS and IS was assessed by measuring their urinary excretion rates in participants with normal kidney function. Studies were carried out in 15 vegetarians and 11 individuals consuming an unrestricted diet. Participants recorded food intake over 4 days and collected urine over the final 2 days of each of two study periods, which were 1 month apart.

Dietary protein-fiber ratio associates with circulating levels of indoxyl sulfate and p-cresyl sulfate in chronic kidney disease patients

M. Rosol†‡, D.W. Johnson, H. Xu, J.J. Carraro, E. Pascoe, C. French, K.L. Campbell

DOI: http://dx.doi.org/10.1002/nanor.2015.03.015 | CrossMark

Article Info
Uremic Toxins Reduced in Vegetarian Diets

Indoxyl sulfate and p cresyl sulfate are protein-bound uremic toxins

- Reduced (by 50%) in those on hemodiafiltration eating vegetarian diets\(^1\)

- Possible mechanisms:
  - Alterations in gut microbiome
  - Increased frequency of bowel movements
  - Inherent differences in proteins


Image: Ibid.

Figure 1 Plasma concentrations of indoxyl sulfate and p cresyl sulfate in non-vegetarian and vegetarian patients. Results expressed as median (interquartile range). *P < 0.05 vs. non-vegetarian.
Plant Foods & Uremic Toxins

- Recurrent signal in the literature
- Cross-sectional study of 22 patients on hemodialysis\(^1\)
- Higher adherence to a plant-based diet index (PDI) was associated with lower indoxyl sulfate levels
  - A healthy PDI was associated with lower indoxyl sulfate levels compared to an unhealthy PDI
- Animal fats, sweets and desserts were associated with bacteria linked to higher indoxyl sulfate and p-cresyl sulfate concentrations
- Indoxyl sulfate has been shown to predict not only need for dialysis but also cardiovascular disease

Effect of Increasing Dietary Fiber on Uremic Toxins in Hemodialysis

- Randomized controlled trial of 56 patients on hemodialysis
- An increase in fiber intake was shown to significantly reduce plasma levels of indoxyl sulfate by 17% (p = 0.04) and non-significantly reduced plasma levels of p-cresol by 8% (p = 0.63)

Single Arm Trial of Psyllium Demonstrated Urea Reduction

- 9 patients with a mean creatinine clearance of 8.2 ml/min
- Given “ispaghula” husk (psyllium) 3.5 g BID for 8 weeks
- Demonstrated
  - 17% reduction in urea after 4 weeks
  - 19% reduction in urea after 8 weeks
  - 4 patients discontinued psyllium after a week due to flatulence and “a sensation of fullness”

Table 2: Effect of ispaghula (7 g/d for 8 weeks [weeks 4-11 inclusive]) on plasma urea and creatinine concentrations and their rates of change (d urea/dt and d creatinine/dt) in uraemic patients (Expt 2). Means ± SEM are shown.

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>0</th>
<th>4</th>
<th>8*</th>
<th>12*</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>urea (mmoles/l)</td>
<td>32±2</td>
<td>38±3</td>
<td>32±3*</td>
<td>31±3*</td>
<td>37±4*</td>
</tr>
<tr>
<td>d urea/dt (mmoles/l/min)</td>
<td>0</td>
<td>+6±1</td>
<td>-6±2*</td>
<td>-1±2*</td>
<td>+7±2*</td>
</tr>
<tr>
<td>creatinine (mmoles/l)</td>
<td>794±76</td>
<td>893±97*</td>
<td>838±107</td>
<td>869±111</td>
<td>893±111*</td>
</tr>
<tr>
<td>d creatinine/dt (mmoles/l/min)</td>
<td>0</td>
<td>+99±32</td>
<td>-55±38*</td>
<td>+31±23</td>
<td>+99±32*</td>
</tr>
</tbody>
</table>

1P < 0.05 from 0 weeks; 2P < 0.05 from 4 weeks; 3P < 0.05 from 12 weeks; 4P < 0.01 from weeks 4-11 inclusive; 5samples taken after 4 and

FAMOUS KIDNEYS

BILLY THE KIDNEY

NICOLE KIDNEY

HELLO KIDNEY

JOHN F. KIDNEY

THE KIDNEY AND I

KIDNEY ROCK
Common Concerns with Plant-Based Diets in Dialysis

Potassium and Protein
Potassium
Plant-Based Foods, Potassium, and ESRD

- Historically, plant-based foods have been excluded from “renal diets” due to their potassium content.
- However, recent research suggests that this risk may be overstated.
- Factors mitigating a rise in serum potassium in ESRD with plant-based foods:
  - Fiber - Leads to larger and more frequent bowel movements, leading to potassium loss.
  - Colonic Secretion of Potassium - In CKD, up to 80% of dietary potassium can be secreted into the colon!
  - Intracellular Movement of Potassium - Due to improved insulin sensitivity and natural alkali found in foods.
  - Bioavailability (next slide)

Bioavailability of Potassium in Plant Foods is Less than Animal Foods

- Cells of plants and animals differ
- Plants have cell walls; animals do not
- Plant cell walls are difficult to digest
  - Potassium is generally found inside cell-walls
- Potassium in plants is no more than 60% in unprocessed fruits and vegetables

PRACTICAL ASPECTS

Potassium Additives and Bioavailability: Are We Missing Something in Hyperkalemia Management?
Kelly Piard, BSC, RD

Hyperkalemia and hyperphosphatemia are common metabolic disturbances in chronic kidney disease. Management may include instructions on a low-potassium or low-phosphorus diet, respectively. Low-phosphorus diet teaching includes information on phosphorus additives in addition to naturally occurring phosphorus food sources. Phosphorus additives are known to be more bioavailable compared with naturally occurring phosphorus. The concentration of phosphorus can also be much higher in processed foods compared with whole foods. Similar considerations may also be needed for dietary potassium teaching. The use of potassium additives...

International Journal of Food Sciences and Nutrition, August 2008; 59(5): 438-450

An investigation into the bioaccessibility of potassium in unprocessed fruits and vegetables

DONALD J. NAISMITH & ALESSANDRO BRASCHI
Department of Nutrition & Dietetics, King's College London, London, UK
Most of the case reports are attributed to juices, sauces, and dried fruit - not unprocessed plant foods
Got Hyperkalemia?

Editorial

Does an Apple (or Many) Each Day, Keep Mortality Away?
Ranjani N. Moordhi


In this issue of the *Clinical Journal of the American Society of Nephrology*, Saglimbene et al. (1) highlight the importance of fruit and vegetable intake in 9757 patients undergoing from this study demonstrate that it is dramatically lower in those on hemodialysis compared with the general population. As the authors point out, patients

The inadvertent consequence of this avoidance is that they fail to derive benefits from fruits and vegetables such as the antioxidants, fiber, and other benefits. Despite this recommendation, there is actually little data to support that eating fruits and vegetables increases serum potassium.
Summary of Evidence Showing Nearly No Increase in Potassium with Plant-Based Diets

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity of Plants Consumed</th>
<th>Size</th>
<th>Duration/Type</th>
<th>Increase in Potassium?</th>
<th>Stage of CKD</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goraya Kidney Int 2012</td>
<td>Typically 2 to 4 cups</td>
<td>199</td>
<td>30 days Controlled trial</td>
<td>No</td>
<td>I/II</td>
<td></td>
</tr>
<tr>
<td>Goraya Kidney Int 2014</td>
<td>2 to 4 cups</td>
<td>108</td>
<td>3 years RCT</td>
<td>No</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>Tyson CKJ 2016</td>
<td>DASH diet</td>
<td>10</td>
<td>2 weeks Controlled trial</td>
<td>No</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>Moorthy AJN 2014</td>
<td>70% plant protein</td>
<td>13</td>
<td>4 weeks Controlled trial</td>
<td>No but</td>
<td>III/IV</td>
<td>1 patient with type IV RTA</td>
</tr>
<tr>
<td>Barsotti Nephron 1996</td>
<td>Vegetarian diet</td>
<td>37</td>
<td>3 months Controlled trial</td>
<td>No</td>
<td>III-V</td>
<td>14 months data on K not reported</td>
</tr>
<tr>
<td>Goraya CJASN 2013</td>
<td>2 to 4 cups</td>
<td>76</td>
<td>1 year RCT</td>
<td>No</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Wu Nephrology 2011</td>
<td>Vegetarian diet</td>
<td>19</td>
<td>Cross-sectional</td>
<td>No</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>St-Jules J Ren Nutr 2016</td>
<td>Increasing K+ intake</td>
<td>140</td>
<td>Cross-sectional</td>
<td>No</td>
<td>HD</td>
<td>No correlation b/w serum K+ &amp; dietary K</td>
</tr>
<tr>
<td>Seglimbene JASN 2019</td>
<td>Median 8 servings F+V/week</td>
<td>8078</td>
<td>Prospective observational (median 2.8 years)</td>
<td>No</td>
<td>HD</td>
<td></td>
</tr>
<tr>
<td>Gonzalez Ortiz NDT 2020</td>
<td>Plant-based diet score</td>
<td>150</td>
<td>Prospective (1 year)</td>
<td>No</td>
<td>HD</td>
<td></td>
</tr>
</tbody>
</table>
The One Patient with Hyperkalemia (with a known Type IV RTA)

“There were a total of 2 incidences of potassium of 5.8 mEq/l and both these measures were in the same subject, with a known type IV RTA, which required modifying the plant protein source from raw edamame (482 mg of potassium/100 g) the highest potassium content among all plant sources (National Database for Standard Reference: USDA Release 26) to fried tofu.”

## Foods with the Most Potassium

<table>
<thead>
<tr>
<th>NDB_No</th>
<th>Description</th>
<th>Weight(g)</th>
<th>Measure</th>
<th>Potassium, K (mg) Per Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>19304</td>
<td>Molasses</td>
<td>337.0</td>
<td>1.0 cup</td>
<td>4934</td>
</tr>
<tr>
<td>11432</td>
<td>Radishes, oriental, dried</td>
<td>116.0</td>
<td>1.0 cup</td>
<td>4053</td>
</tr>
<tr>
<td>11382</td>
<td>Potatoes, mashed, dehydrated, granules with milk, dry form</td>
<td>200.0</td>
<td>1.0 cup</td>
<td>3696</td>
</tr>
<tr>
<td>16049</td>
<td>Beans, white, mature seeds, raw</td>
<td>202.0</td>
<td>1.0 cup</td>
<td>3626</td>
</tr>
<tr>
<td>16108</td>
<td>Soybeans, mature seeds, raw</td>
<td>186.0</td>
<td>1.0 cup</td>
<td>3342</td>
</tr>
<tr>
<td>16045</td>
<td>Beans, small white, mature seeds, raw</td>
<td>215.0</td>
<td>1.0 cup</td>
<td>3315</td>
</tr>
<tr>
<td>19355</td>
<td>Syrups, sorghum</td>
<td>330.0</td>
<td>1.0 cup</td>
<td>3300</td>
</tr>
<tr>
<td>12005</td>
<td>Seeds, breadnut tree seeds, dried</td>
<td>160.0</td>
<td>1.0 cup</td>
<td>3218</td>
</tr>
<tr>
<td>16040</td>
<td>Beans, pink, mature seeds, raw</td>
<td>210.0</td>
<td>1.0 cup</td>
<td>3074</td>
</tr>
<tr>
<td>16071</td>
<td>Lima beans, large, mature seeds, raw</td>
<td>178.0</td>
<td>1.0 cup</td>
<td>3069</td>
</tr>
<tr>
<td>16119</td>
<td>Soy meal, defatted, raw</td>
<td>122.0</td>
<td>1.0 cup</td>
<td>3038</td>
</tr>
<tr>
<td>01115</td>
<td>Whey, sweet, dried</td>
<td>145.0</td>
<td>1.0 cup</td>
<td>3016</td>
</tr>
<tr>
<td>16014</td>
<td>Beans, black, mature seeds, raw</td>
<td>194.0</td>
<td>1.0 cup</td>
<td>2877</td>
</tr>
</tbody>
</table>

(Almost) No Association Between Dietary Potassium & Serum Potassium Pre-Dialysis

- Secondary analysis of 224 patients on dialysis in the Nutritional and Inflammatory Evaluation in Dialysis
- Only 2% of the variance in quarterly mean predialysis serum potassium
- Based on this data, increasing dietary potassium 9-fold – from 500 mg to 4500 mg per day, would be expected to increase serum potassium by only 0.4 mEq/L

No Association Between Dietary Potassium & Serum Potassium Pre-Dialysis

- 140 HD patients in the BalanceWise Study
- “No significant correlations were found between [serum potassium] and either absolute reported potassium intake ($r = 0.06, P= 0.50$) or potassium density ($r = -0.003, P= 0.97$)”

Not all potassium sources are the same

**Nutrient Non-equivalence: Does Restricting High-Potassium Plant Foods Help to Prevent Hyperkalemia in Hemodialysis Patients?**

David E. St-Jules, RD, PhD,* David S. Goldfarb, MD,† and Mary Ann Sevick, ScD, RN*

Hemodialysis patients are often advised to limit their intake of high-potassium foods to help manage hyperkalemia. However, the benefits of this practice are entirely theoretical and not supported by rigorous randomized controlled trials. The hypothesis that potassium restriction is useful is based on the assumption that different sources of dietary potassium are therapeutically equivalent. In fact, animal and plant sources of potassium may differ in their potential to contribute to hyperkalemia. In this commentary, we summarize the historical research basis for limiting high-potassium foods. Ultimately, we conclude that this approach is not evidence-based and may actually present harm to patients. However, given the uncertainty arising from the paucity of conclusive data, we agree that until the appropriate intervention studies are conducted, practitioners should continue to advise restriction of high-potassium foods.

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Fiber Increases Fecal Potassium Excretion

- **Single patient study**
- **Patient** was on dialysis and given 3.5 g twice a day of ispaghula (psyllium) for 11 weeks
- **Researchers** noted a 32% increase in fecal potassium excretion

![Table 3](image)

Colonic Potassium Excretion Increased in Patients with ESRD

- Compared to patients with normal renal function, rectal K secretion is nearly 3x higher in patients with ESRD.
- Colonic potassium excretion appears to be an active process mediated by an upregulation of high-conductance (BK) apical K+ channels in surface colonic epithelial cells.

Protein
Do hemodialysis patients get enough protein on a plant-based diet?

- **HD patients recommended to get 1.0-1.2 g/kg/day**

- **Two studies of vegetarians on hemodialysis showed protein intake of 1.2-1.25 g/kg/day without compromise** \(^1,2\)

- **Unclear from studies if their diets were modified in any way (versus eating ad lib) or supplemented with protein-containing foods**

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A Variety of Plant-Foods Provide Adequate Protein with Typical Consumption

PRACTICAL ASPECTS

Adequacy of Plant-Based Proteins in Chronic Kidney Disease

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Concerns regarding protein and amino acid deficiencies with plant-based proteins have precluded their use in chronic kidney disease (CKD) patients. Many of these concerns were debunked years ago, but recommendations persist regarding the use of “high-biological value” (animal-based) proteins in CKD patients, which may contribute to worsening of other parameters such as blood pressure, metabolic acidosis, and hyperphosphatemia. Plant-based proteins are sufficient in meeting both quantity and quality requirements. Those eating primarily plant-based diets have been observed to consume approximately 1.0 g/kg/day of protein, or more. CKD patients have been seen to consume 0.7-0.9 g/kg/day of mostly plant-based protein without any negative effects. Furthermore, those substituting animal-based proteins for plant-based proteins have shown no effects in terms of blood pressure, hyperphosphatemia, and other.

It is important to note that amino acid deficiency is possible in those who are eating a restrictive diet limited to one or two food sources, creating a situation such that attainment of the RDA for an amino acid may exceed the number of servings than is humanly possible. A stark example of this can be illustrated by the low tryptophan content of an apple. A medium-sized (100 g) apple contains 1 mg of tryptophan. Based on the RDA for tryptophan (5 mg/kg/day), a 70-kg person would need on average 350 mg of tryptophan per day. To meet this, a person eating a diet exclusively of apples would need to eat 350 apples daily to meet the RDA for tryptophan, which is not possible in a real-world scenario.
Less Protein But Better Nutritional Status?

- 150 patients on dialysis followed prospectively for a year
- 3-day food record every 3 months & characterized by a healthy plant-based diet score
- Those with a higher plant-based diet score had a higher risk of low protein intake (< 1.1 g/kg/d OR 1.11, 95% CI 1.04-1.19)
  - Intake was 0.9 g/kg/d in moderate & high groups

- However, those with a higher plant-based diet score also had a lower malnutrition inflammation score (aka better nutritional status)
- Diet still wasn’t healthy!
  - Overall low intake of legumes, fruits, and vegetables!

Concluding Thoughts
“An ounce of prevention...”
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Thank You!

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Questions?