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The Benefits of Vegetarian Diets in Chronic Kidney Disease

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One only needs to reflect on the past 40 years of dialysis therapies to fully appreciate its transformation. The field of dialysis has been evolving from its early beginnings to what it is today: early diagnosis of chronic kidney disease (CKD), innovations in dialysis-related technology and advances in the treatment of corresponding anemia and bone disease. Despite these amazing advances, perceptions about vegetarianism have not progressed as quickly. The myths of plant protein being inferior to animal protein still remain. The fear of utilizing plant-based foods is likely due to a clinging to "old vegetarian myths." Examples of these myths include the belief that such a diet could cause potassium and phosphorus levels to rise and that plant proteins do not meet the needs of the dialysis population. As a result of these beliefs, plant-based protein options are not commonly introduced to our patients.

Vegetarianism and plant-based diets are not inferior to animal-based food choices. Plant-based protein can be equal to, if not superior to animal-based protein quality (1). A recent study looked at nineteen vegetarian dialysis patients compared to 299 non-vegetarians, over a six month period of time, and found no difference in albumin levels, hand grip strength or subjective global assessment (SGA) scores (2). Although much concern has been raised regarding the phosphorus originating from plant-based proteins, this concern is minor compared to the exponential increase in phosphate additives within our food supply. In the 1990's, phosphorus additives contributed approximately 500 mg per day to the American diet. Today, phosphate additives contribute as much as 1000 mg per day to the average American diet (3). Animal-based phosphorus is bound to protein but is easily hydrolyzed and readily absorbed. Plant-based phosphorus found in nuts, cereals, and dried cooked beans is primarily in the form of phytic acid or phytates. Since humans do not have the enzyme phytase, the biological availability of plant-based phosphorus is less than 50%, in contrast to an estimated 70% bioavailability from phosphates in animal protein (3). In comparison, phosphates from processed foods, including colas and many other flavored beverages, cereals, frozen meals and enhanced meat products, are not bound to protein or phytates. These phosphates are salts that are readily disassociated. Consequently the absorption of the inorganic phosphorus is increased to over 90% (3).

Potassium concerns need not be a barrier for a patient to successfully follow a plant-based diet. Lower potassium options can be suggested such as tofu, seitan or lower potassium beans such as lentils, pinto beans or kidney beans (in place of navy or soy beans). In addition, adjustments can be made in a patient's fruit and vegetable consumption to allow for more plant-based proteins.

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Plant-based foods are cell protective and they offer a variety of phytochemicals and phytoestrogens not present in animal-based foods. Advanced glycation end-products (AGE) are more prevalent in animal-based products.

Introducing the healthy benefits of plant-based foods in easy-to-prepare and creative ways is one more approach to promote health, prevent disease progression and co-morbid conditions in the person coping with kidney disease or at risk for kidney disease. Patients may choose to not adhere to a diet that is 100% vegetarian; however adding plant-based options to the diet is still beneficial to patient health. When counseling patients at earlier stages of CKD, the introduction of diets that replace animal protein with plant-based protein choices may decrease proteinuria, improve blood pressure control and decrease hyperfiltration (4-9).

Disturbances in mineral metabolism can begin in CKD Stages 3 and 4. The damaged kidney is unable to tolerate a large phosphate load leading to an elevated parathyroid hormone (PTH) level, and fibroblast growth factor 23 (FGF-23) contributing to heart disease and kidney disease progression (10,11). Studies show even one week on a vegetarian diet can decrease phosphorus levels and FGF-23. These same results are not found with animal protein-based diets (12).

The Protective Role of Plant-Based Diets in CKD

Glomerular capillary hypertension was first associated with protein rich diets in 1982 (13). Since then, studies have consistently isolated substances of plant protein that are kidney protective and can slow the progression of CKD (7,12,14-17). According to the National Health and Nutrition Examination Survey (NHANES) there is an inter-relationship among diabetes, cardiovascular disease, hypertension and CKD (18). A plant-based diet that emphasizes the use of plant protein is a means of decreasing the incidence of these interrelated co-morbidities. This is accomplished by decreasing the inflammatory response, adding antioxidant protection and improving immunity.

Inflammation

Comprehensive care for those with CKD involves not only treating the disease but managing and reducing the associated inflammation. Those with CKD are susceptible to oxidative damage and the formation of AGEs. What ensues is a never-ending cycle rife with the formation of free radicals and productions of pro-inflammatory cytokines. Because of this cycle of inflammation, those with CKD often have other complex conditions that result from chronic inflammation. These conditions include cardiovascular disease, atherosclerosis and stroke (19,20).

Implementing a vegetarian diet shows promise in attenuating the inflammatory response (21). Higher consumptions of fruits and vegetables is associated with lower C-reactive protein (CRP) levels (22). Specific components in plant foods, such as isoflavones, produce effects that modulate cell protection and mimic the action of natural COX 2 enzyme inhibition, contributing to anti-inflammatory effect (23,24).

Plant-based diets offer more options for increasing fiber consumption. This in turn promotes the formation of bacteria friendly to the intestinal tract, which can attenuate systemic inflammatory responses (25). Finally, because the fat content of a plant-based diet is often low, there is less risk that cooking methods will promote AGE product formation (26,27).

Oxygen Radical Absorbance Capacity (ORAC) of Foods

Antioxidants are a diverse group of chemical substances found in fruit, vegetables and other plants. They include, but are not exclusive to enzymes, Vitamin C, Vitamin E and beta-carotene. Antioxidants work by decreasing free radical formation related to oxidative damage and disease. Some of these degenerative diseases include cardiovascular disease, cancer and atherosclerosis.

As a means to quantify the antioxidant content of a given food, the ORAC designation was developed by the National Institute of Health in the early 1990s. The data is reported in micromole Trolox Equivalents (TE/µmol) per typical serving size and is a measurement of the antioxidant capacity of a food. Although the ORAC assays have been criticized for lack of in vivo validation and variation in values from sample to sample, they do offer a guideline for identifying antioxidant-rich foods that are potentially beneficial to our patients. The higher the ORAC value, the better the capacity of the food to neutralize free radicals. The recommended intake of ORAC is 3000-5000 TE/µmol per day (28). Table 1 lists high ORAC foods that are also low in potassium, given the serving listed. This is one tool for teaching our patients how to add antioxidant-rich foods to their diet while keeping potassium levels in a safe range.

Gut Health

Gut-associated lymphoid tissue generates almost 70% of the body's antibodies and accounts for the predominance of lymphocytes in the body (2). Processed foods and low fiber diets, and multiple medications promote unhealthy gut flora. This may manifest as a multitude of gastro-intestinal complaints, such as gas, bloating, diarrhea or even constipation. Plant-based diets provide a way to maintain intestinal microflora by promoting gut health to improve patient immune system function (25,29). Metabolites of plant-based food promote Equol and O-desmethylangolensin (O-DMA). Equol and O-DMA are end metabolite biotransformations from the phytoestrogen Daidzein. Both end-products have been found to be in higher concentration in the guts of vegetarians vs. non-vegetarians, and may be associated with

Table 1
TOP ORAC VALUE FOODS

FRUITS/VEGETABLES[1,2] ½ cup portions				SPICES/NUTS/BEANS[1,2]			
FOOD	**ORAC[3] (TE/µmol)**	**Phos (mg)**	**K+ (mg)**	**FOOD**	**ORAC[3] (TE/µmol)**	**Phos (mg)**	**K+ (mg)**
Raspberries	3002	8	94	Cinnamon, 1 tsp	6956	1	11
Strawberries	2969	14	120	Oregano, 1 tsp dried	3602	3	25
Blueberries	4848	8	65	Turmeric, 1 tsp	N/A	6	57
Cranberries	4792	5	34	Rosemary, 1 tsp	N/A	<1	11
Asparagus	1441	25	72	Pinto Beans Dry, ½ cup cooked	4000-5000	137	300
Broccoli Raab, raw	620	15	39	Almonds, 1 oz (22 nuts)	1260	128	186
Brussels Sprouts, raw	980	30	171	Peas, ¾ cup cooked	400	118	265
Cabbage, raw	3145	8	86	Pecans, 1 oz (19 halves)	5086	79	116

1 Food and Nutrition Information Center. USDA National Nutrient Database for Standard Reference. Available at: *http://www.nal.usda.gov/fnic/foodcomp/search/*.
2 Pennington JA, Douglass JS. Bowes and Church's Food Values for Portions Commonly Used. 18th Edition. Lippincott Williams & Wilkins: Baltimore, 2005.
3 U.S. Department of Agriculture. *Oxygen Radical Absorbance Capacity (ORAC) of Selected Foods* – 2007. Available: *http://www.ars.usda.gov/nutrientdata*.

reduced risk of certain diseases, including breast and prostate cancers (30,31). Isoflavones have been shown to slow down the progression of CKD with the added benefit of reducing inflammation in the aforementioned co-morbidities (9,32,33).

Environmental Disruptors

Humans are exposed to toxins from our environment on a daily basis (34-38). As our patients live longer, our nutrition education needs to take into consideration diet choices for long-term protection from these environmental insults. One example is the estrogen that we are exposed to exogenously. Exogenous estrogens, also known as endocrine disruptors or xenoestrogens, can originate from the environment in the form of plastic, herbicides, food additives or cigarette smoke (34-38). Other dietary sources include animal fats, charbroiled meats and AGE products. The extent to which these disruptors contribute to disease is only beginning to be understood but it is postulated that they play a role in the genesis of autoimmune disorders, cancers and neurological disorder (39).

Many plant-based proteins and plant-based foods work to antagonize the negative effects of the exogenous estrogens. Commonly referred to as phytoestrogens or functional estrogens, these food properties can be broken down into several subcategories: lignans, stilbene, stilbenoids, coumestans and flavinoids. Examples of these foods are found in Table 2 (31,40,41).

Table 2
Sources of Phytoestrogens

- Fiber – lignan (flax, wheat, rye)
- Dried cooked beans
- Isoflavones
- Curcumin (tumeric)
- Rosemary
- Limonene – citrus
- Sulfur (onion, shallots)
- Artichokes
- Flavionoids – citrus, grapes
- Soluble Fiber – oats, legumes
- Indole 3 Carbinol – broccoli, cauliflower, brussels sprouts, cabbage

Summary

Plant-based diet offer many advantages to our patients; not only in positively altering the progression of kidney disease but in preventing co-morbid conditions. Plant-based proteins can be added easily and safely to our patient's diets, providing the same quality as animal protein with additional benefits. Whether working with dialysis patients, CKD or transplant patients, registered dietitians (RDs) need to feel comfortable working with a variety of plant-based foods in order to help patients introduce these foods to their diet. Included with this article are recipes that are aimed at making it easy for the RDs to introduce plant-based foods safely and in tasteful, creative ways.

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