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Letter to the Editor

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Soybean Products Consumption in Chronic Kidney Disease: Cons and Pros

Ali Amirinejad [1, 2], Emad Yuzbashian [3*]

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✉ **Emad Yuzabshian**
e_yuzbashian@yahoo.com

[1] Nutrition and Food Security Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[2] Department of Nutrition, Faculty of Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[3] Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada

Chronic kidney disease (CKD) has become a global health challenge affecting 11% to 13% of the world population *[1]*. Routinely, patients with advanced stages of CKD (stage 3-5) are advised to adhere to a strict diet that limits specific nutrients. Legumes consumption, including soy products, containing a high amount of phosphorus and potassium, is usually restricted in the diet of patients with CKD *[2]*. However, because of the anti-inflammatory, antioxidant, cholesterol-lowering, and blood pressure-lowering features of dietary soy *[3]*, recent studies suggest that soy products could have beneficial effects in people with CKD.

Dyslipidemia and cardiovascular disease (CVD) are common complications in patients with CKD. Cardiovascular disease is responsible for 40-50% of deaths in patients undergoing dialysis *[4]*. It is well-established that soy protein and isoflavones have a beneficial role in the prevention of CVD by decreasing serum triglyceride (TG), total cholesterol (TC), and LDL-cholesterol (LDL-C) and increasing serum HDL-cholesterol (HDL-C) *[5]*. Several randomized clinical trials showed that prescription of soy protein or isoflavones in patients undergoing peritoneal and hemodialysis is accompanied by an increase in serum HDL-C and a decrease in serum TG, TC, LDL-C, and lipoprotein (a) [LP(a)]. Increased levels of serum LP(a) are involved in the pathogenesis of CVD *[6, 7]*.

Maintaining blood pressure in the normal range is a vital strategy in inhibiting CKD progression. Soy isoflavones decrease blood pressure by producing nitric oxide, a molecule with vasodilation properties. Several studies have shown that soy consumption is associated with lower systolic and diastolic blood pressure *[8]*.

Insulin resistance and diabetes are another two major risk factors in the progression of CKD. Several studies have investigated the possible role of soy products in controlling glycemic indices. Adhering to a high soy protein diet for 4 years resulted in a decreased fasting blood glucose concentration compared to an animal protein diet in patients with diabetes *[9]*. Soy protein consumption in patients with hypercholesterolemia was accompanied by a significant reduction in serum insulin levels compared with milk protein *[6]*. Furthermore, the results of a systematic review of 11 cohort studies showed that total protein and animal protein could increase the risk of T2DM; however, the plant

protein, including soy protein decreased the risk of T2DM *[10]*.

Osteoporosis is another frequent disorder that occurs in patients with CKD. Soy products arerich sources of phytoestrogens, including genistein and daidzein, which have structural similarities with the estrogen hormone. Several studies reported that soy phytoestrogens improve bone formation by mimicking estrogen functions. The soy phytoestrogens showed a greater affinity for estrogen receptor β (ER-β) rather than estrogen receptor α (ER-α) and therefore may be better considered as selective estrogen receptor modulators *[11, 12]*. A recent clinical trial indicated that daily administration of 100 mg soy isoflavone supplement to patients on peritoneal dialysis declines serum N-telopeptide and RANKL; two bone resorption markers*[13]*.

Despite all these advantages, possible side effects, including drug interactions and allergies in some populations should be considered in the regular consumption of soy products. There are two major concerns related to the consumption of soy products in patients with CKD: protein adequacy and high phosphorus content.

Protein

Protein-energy malnutrition is prevalent among patients with CKD. Many factors, including anorexia, inflammation, metabolic acidosis, bowel flora alteration, and hormonal dysregulations, are involved in this case *[14]*. Guidelines suggest protein intake of 0.6–0.8 g/kg/day for patients with CKD who are not on dialysis and 1.0–1.2 g/kg/day for patients on peritoneal dialysis or hemodialysis*[15]* At least half of this amount should be of a high biologic value which exists in fish, eggs, poultry, meat, and dairy products*[15]*. However, *Chen et al.* indicated that substitution of soy protein (30 g/d) for animal protein could maintain the nutritional status in patients on hemodialysis *[6]*. Furthermore, a meta-analysis of 12 RCTs showed that receiving soy products in pre-dialysis and dialysis patients has no negative effects on body weight, body mass index, and serum albumin levels*[16]*.

It seems that soybean as a source of high-quality protein contains all of the essential amino acids *[17]*, and can provide the protein needs of patients with CKD.

Phosphorus

The kidneys play an essential role in phosphorus homeostasis. When the renal function starts to decline the hyperphosphatemia occurs due to phosphate retention. Hyperphosphatemia leads to secondary hyperparathyroidism and ultimately bone disease *[18]*. Limiting dietary phosphorus is a routine strategy to maintain blood phosphate levels in the normal range. Traditionally, recommendations suggest maintaining phosphorus intake between 800 and 1,000 mg/d in patients with stages 3-5 of CKD and those receiving dialysis to maintain serum phosphate levels in the normal range. Recent recommendations focus on the source of dietary phosphorus rather than determining specific daily intake. Omitting processed foods with phosphorus additives and replacing plant-based phosphorus with animal sources is considered as rational and practical advice *[19]*. *Moe SM et al.* showed that adherence to a vegetarian diet led to a lower blood phosphate compared to meat proteins *[20]*.

Similarly, although soy products are known as rich sources of phosphorus, they have no impressive effects on raising blood phosphate. Most of the phosphorus, in the plant proteins is in the form of phytate, which is less bioavailable than animal protein (30%-50% vs. 70%-80%) *[21]*. Results of a systematic review and meta-analysis indicated that dietary soy was associated with a significant reduction in serum phosphorus in patients with pre-dialysis *[16]*. Therefore, soy products can be included in the diet of patients with CKD, especially when serum phosphate levels are monitored.

Considering the beneficial effects of soy products on preventing osteoporosis, and CVD, patients with

CKD might benefit from including soy products in their diet.

Authors' contributions

A A wrote the manuscript. E Y supervised the study. All authors approved the final version of the manuscript.

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Conflict of Interest

The authors declare that they do not have competing interests.

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