



BCKD₁₈
BC KIDNEY DAYS

**Vegetarian Diets and CKD.
Way to go?**

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Vegetarianism

Encompasses the practice of following plant based diets with the exclusion of all animal flesh.

Types:

- Lacto-ovo vegetarians
- Lacto vegetarians
- Ovo vegetarians
- Vegans
- Pescatarians
- Semi-vegetarians

POLLING QUESTION 1:

How many individuals in the audience are:

- a. Vegetarians
- b. Vegans
- c. Non-vegetarians

Vegetarianism

Reasons:

- Religious and philosophical
- Economical
- Environmental
- Health benefits and disease prevention



POLLING QUESTION 2:

What are the reasons your patients choose a vegetarian way of eating?

- a. Religious
- b. Meat aversion
- c. Environmental
- d. Ethnic eating pattern
- e. Improve health

Prevalence of Vegetarian Diets

In 2015

- 12% of young Canadians claimed to be vegetarian compared to 5% of Canadians 50 and older.
- British Columbia has the highest share among Canadian provinces. It went up from 13% to 16% in 2018.
- Dalhousie University poll in March 2018
 - Vegetarians 7.1% and Vegans 2.3%
 - Age, gender and university education
- Impact over the next couple of decades??

Prevalence of Vegetarianism in CKD

- Lack of reports on the prevalence of CKD in vegetarian population.
- The prevalence of HTN, Type 2 Diabetes, metabolic syndrome and obesity is reported to be lower in vegetarian populations
- Assume renal consequences of above diseases be less prevalent among vegetarians ?
- Plant-based diets are associated with a decrease in risk factors associated with CKD progression.

Nutrients in Vegetarian Diets

Vegetarian		Vegan
Rich in	Low in	Compared to Vegetarian,
n-6 Fatty acids Dietary Fibre Folic acid Potassium Magnesium Vitamin C Vitamin E Carotenoids Phytochemicals	Saturated fat n-3 Fatty acids Zinc Iron	Higher in dietary fibre Lower in cholesterol calcium vitamin D vitamin B12

Energy and Nutrient Intake in vegetarians

EPIC-Oxford study

- British vegetarian men and women >20 years of age.
 - 65,000 subjects
 - 50% meat eaters
- Vegetarians had 5% lower energy intake (Vegans 14% lower)
- CHO intake 51.2% vs 46.9%
- Protein intake as % of energy intake 13.1% vs 16%
- Saturated fat intake was lower, polyunsaturated fat was higher
- No significant difference in height, weight BMI between lifelong vegetarians and those who became vegetarians at older than 20 years of age
- No difference in fracture rates between vegetarians and non-vegetarians. Risk was 30% higher in vegans

Academy of Nutrition and Dietetics (and): Position paper on Vegetarian Diets

- A well planned varied vegetarian diet is nutritionally adequate for all stages of the life cycle. From infancy to old age, for athletic performance and pregnancy.

Health Benefits:

- Lower incidence of diabetes, cardiovascular disease, obesity, hypertension, cancer and mortality.

Association of Animal and Plant Protein intake with All-Cause and Cause-Specific Mortality

Prospective cohort study of US Healthcare Professionals and Nurses Health Study 1980-2012

- Data analyzed from 2014-2016
- The median protein intake as assessed by % of energy intake
- 14% for animal protein
- 4% for plant protein

Results:

- Animal protein intake was not associated with all-cause mortality. It was associated with higher cardiovascular mortality
- Plant protein intake was associated with lower all-cause mortality (10%) and lower cardiovascular mortality (12%)
- Confined to participants with at least one unhealthy lifestyle factor

Association of Animal and Plant protein Intake with All-Cause and Cause-Specific Mortality

- Replacing animal protein of various origins with plant protein was associated with lower mortality
- The hazard ratio for all cause mortality when 3% of energy from plant protein was replaced with an equivalent amount of protein from:

Processed red meat	0.66
Unprocessed red meat	0.88
Egg	0.81

This suggests the importance of protein sources

Dairy products and CKD: Protective or harmful?

A systematic review of prospective cohort studies.

- Of the 361 articles extracted from the databases, 7 were included in the review.
- Five reported a protective association for dairy consumption, particularly low- fat dairy, against incident CKD or rapid decline in renal function. However, two studies did not find such association.

Association of Plant Protein Intake With All-Cause Mortality in CKD

NHANES III

- Cohort of 14866 participants stratified by eGFR <60 or >60ml/min/1.73m²
- 24 –hour dietary recall
- Mean total protein intake and plant protein: total protein ratio
- Average follow up of 8.4 years

Result:

In patients with eGFR <60ml/min, each 33% increase in the plant protein: total protein ratio was associated with a lower mortality risk (HR 0.77)

Plant protein vs animal protein

Nurse's Health Study 1 and 2, and Health Professionals Follow-up Study:

- Higher intake of animal protein is associated with an increased risk of type 2 diabetes compared with higher intake of vegetable protein

Nurses' Health Study:

- Women with CKD consuming a high animal protein diet had a significantly greater decline in eGFR than women who consumed more plant protein

The Goal of Diet Therapy for Vegetarian with Chronic Kidney Disease

- Decrease the rate of progression of renal failure
- Decrease proteinuria
- Minimize protein catabolism
- Maintain good nutritional status
- Provide adequate calories and protein
- Minimize uremic toxicity
- Correct metabolic acidosis
- Decrease risk of secondary complications associated with kidney disease such as heart disease, bone disease and hypertension

Vegetarian Diets and CKD

Questions that arise:

- Is a vegetarian diet nutritionally safe to use in people with CKD or on dialysis?
- Is the vegetarian vegan diet prescription likely to cause/worsen malnutrition?
- Would it attain adequate protein intake to meet CKD and dialysis's increased protein requirement?
- Would the caloric intake be sufficient to prevent involuntary weight loss?
- Can K and Phosphorus levels be managed within acceptable limits?
- Would one need supplements? What about calcium, iron, vitamin B12, vitamin D and zinc status?

Vegetarian Diets and Protein

Quality and Quantity

- Animal proteins **viewed** as superior high quality protein

But are they?

- We consume protein as a mixture of assorted foods
- Complementation of amino acids

Vegetarian Diets and Protein in Healthy population

- Recommendation: Protein at 0.8g/kg/day
- Adventist Health Study-2
- EPIC-Oxford Study
- Vegetarian Californians

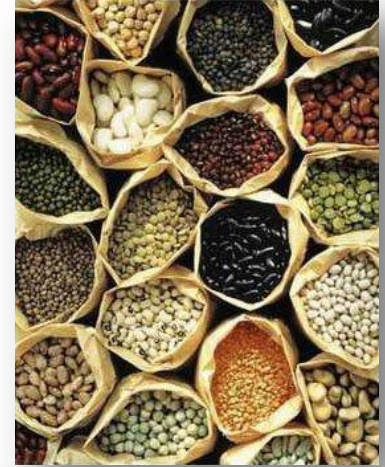
Vegetarian Diets and Protein in CKD

- Protein requirement in CKD at 0.8g/kg
- For dialysis at 1.2-1.3g/kg
- Biological value ?
- PDCAAS (Protein Digestibility-Corrected Amino Acid Score)

Measures protein quality of a specific food based on comparing the aa profile of that food against a standard aa profile.

PDCAAS of Proteins

Beef	0.92
Black beans	0.75
Casein	1.00
Egg	1.00
Milk	1.00
Peanuts	0.52
Soy protein	1.00
Whey protein	1.00
Wheat gluten	0.25



Vegetarian Diets and Protein in CKD

Italian study, stage 3 and 4 CKD patients

Israel Study

- Unrestricted vegan diets can readily attain 0.7-0.9g protein/kg/d
- Patients on dialysis are able to attain 1.1-1.25gprotein /kg without signs of compromise

Vegetarian Diets and Protein

High protein diets are associated with

- Glomerular hyperfiltration
- Increase in proteinuria
- Accelerate progression of kidney disease

Plant- based Diets are closer to estimated average requirement in RDA for healthy population and to the goals set for low protein diet in CKD population.

Concerns regarding malnutrition/PEW using plant- based diets are unfounded

Dietary Protein Sources and Risk for Incident CKD

ARIC study

- 11,952 adults, eGFR => 60ml/min/1.73m²
- Median follow up 23 years
- 2632 incident CKD cases of stage 3 CKD



Result:

- Highest quartile of vegetable protein: reduced risk of incident CKD of 24%
- Red and processed meat increased CKD risk by 23%
- Nuts decreased risk by 19%, legumes 17% , low fat dairy 15% and fish and seafood 11%

Nutritional status of vegetarians on maintenance hemodialysis

- On dialysis for > 6months.
- 19/318 patients were vegetarians

Results:

- nPCR was lower in the vegetarian group 1.10 vs 1.20 (g/kg/day)
- The serum albumin and pre-albumin were similar
- The BMI and mid-arm muscle circumference were lower in vegetarians
- The hematocrit was similar but required a higher EPO dose
- The muscle strength evaluated by the hand-grip test, SGA and activities of daily living were similar

CASE STUDY #1



45 year old male with HTN admitted to hospital with AKI, Creat >800
Creatinine at discharge 530. Diagnosed with pulmonary renal syndrome.
Seen in outpatient clinic as a new patient.

Patient in the meantime has changed his eating habits

Diet History:

Breakfast: Chapati and cabbage. Tea

Mid am: Apple/berries

Lunch: Rice and cabbage.

Mid pm : Apple/berries

Dinner: Rice. Eggplant curry. Tea

Will eat egg once or twice a week.

Protein requirement based on height and weight 55g/day

K and P are within normal limits.

What is the issue here?

POLLING QUESTION 3:

What are the more commonly used protein foods in your vegetarian CKD patients?

- a. Lentils/ Legumes/ Beans
- b. Tempeh
- c. Miso
- d. Nuts
- e. Meat analogs
- f. Tofu

Vegetarian Diets

Phosphorus and CKD

- Phosphorus values based on chemical composition and digestibility in food table data bases. Do they reflect true Phosphorus exposure?

Variation in phosphorus bio-availability:

- Animal based Phosphorus is bound to organic molecules: proteins, phospholipids, nucleic acids
- Phosphorus from plant sources is stored as phytates
- Food additive based phosphorus exists as phosphate salts that readily dissociate in water

Vegetarian diets

Phosphorus and CKD

- Adjusting for bioavailability has important implications for managing hyperphosphatemia of CKD.
- Phosphorus recommendation at 800mg-1000mg/day
- Higher protein diets are associated with a high phosphorus intake
- Linear regression equations in CKD patients

BalanceWise study: Protein and Phosphorus relationship

- Phosphorus intakes vary considerably for a given protein intake
- Relationship is confounded also by energy intake

Phosphorus additives in processed foods

- Why are phosphorus additives used in fast and processed foods?
- Intake of processed foods can provide 300-1000mg of additional phosphorus from additives daily
- Phosphorus information is not on the Nutrition Fact Table
- Have to rely on the ingredient list to locate phosphate salts.



Are Phosphorus additives absorbed 90-100%?

- 3 crossover feeding studies with measured amount of dietary phosphorus in healthy adults
- Assumes 24 h urinary Phosphorus reflects absorbed fraction of dietary Phosphorus
 1. Natural sources (44%) vs Phos additives (48%)
 2. Control diet low in Phos and Ca vs 1000mg additional P from wholegrains (41%), cheese(38%), meat(53%) Additives (54%)
 3. Low Phos additives (46%) vs Enhanced Phos additives (36%)

Did not support high bioavailability of Phosphorus additives.

Vegetarian compared with meat dietary Protein Source and P homeostasis in CKD

Crossover trial in 8 patients with CKD stage 3 or 4

- mean GFR 32ml/min/1.73m²(25-40)
- 7day diet period on each diet

Iso-caloric, protein 20% of energy intake and 800mg P.

Results:

- One week of vegetarian diet led to lower serum phosphorous level and decreased FGF-23 levels
- Source of protein has a significant effect on phosphorus homeostasis in patients with CKD.
- Diet education should include information on amount and the source of protein from which phosphorus is derived.

Restricting phosphorus without compromising protein intake

- Avoid foods with higher phosphorus: protein ratio
- Minimize use of processed foods with phosphate additives.
- Cook meals from scratch using fresh ingredients
- Select foods lower in bioavailable phosphorus
- Use wet methods of cooking such as boiling
- Extra phosphate binder may be required to meet protein requirement and phosphorus control

Vegetarian Diets, Phosphorus and CKD

Phosphorus : protein ratios vary considerably in high protein foods as mg/gram of protein.

Item	Amount	Actual mg P per g protein	Adjusted mg P per g protein
Egg	1 large	14.3	10.5
Cheddar cheese	1oz	20.7	15.3
Cottage cheese	1 cup	10.6 - 10.8	8.1 - 8.7
Milk	1 cup	26.1-30.9	19-26
Nuts	1 oz	18.4-24.5	10.9-14.4
Peanut butter	2Tbsp	12.6-14.8	7.4-8.7
Soybeans boiled	1 cup	14.5	8.5
Sunflower seeds	1 oz	53.7	31.5
Tofu	100g	12.7-13.6	7.5-7.6
yogurt	4ozs	27-29.5	19.8
Red meat	3ozs	8.1-8.6	6.0-6.3

Nutrient Non- equivalence:

Does Restricting High-Potassium Plant Foods Help to Prevent Hyperkalemia in Hemodialysis Patients?

Researched basis for limiting high K foods and concluded that the approach is not evidence-based.

- Dietary K intake is weakly associated with pre-dialysis serum K in HD patients. Dietary K intake from 500mg to 4500mg/day (9 fold increase), serum K was only 0.4meq higher
- BalanceWise study: No significant correlations between serum K and reported absolute K intake or K density

Potassium: factors affecting serum level

- Serum K reflects complex interaction of various intrinsic factors
- Importance of bowel in maintaining K balance. K excretion in HD patients is 3 times higher (37%) vs normal controls (12%)
- Prevalence of constipation in hemo patients (53%).
- Muscle proteins, K additives. Net acid production.
- Plant based fruit and vegetables: High in CHO, fibre, net-base production. Shift K into cells.

Alkaline Diet and Metabolic acidosis

Negative consequences of Metabolic Acidosis:

- Increased risk of kidney disease progression
- Stimulus for protein degradation
- Higher bone degradation

Type of diet can affect MA by providing acid or base precursors

Potential Renal Acid Load(PRAL)

Takes into account intake of protein, P, K, Mg and calcium.

PRAL (meq/day) =

+ 0.49 protein(g/day)

+ 0.037 P(mg/day)

- 0.021 K(mg/day)

- 0.026 Mg (mg/day)

- 0.013 calcium(mg/day)

< zero increases alkalinity

> zero increases acidity

Meat, eggs, cheese and grains increase acid production

Fruits and vegetables are alkalizing. Milk, fats and sugars are neutral

Treatment of metabolic acidosis in patients with CKD with fruits and vegetables or bicarbonate?



Goraya et al , 3 studies in patients with

- Stage 2 CKD with no metabolic acidosis, follow-up 30 days.
- Stage 3 CKD with no metabolic acidosis
- Stage 4 CKD with metabolic acidosis, follow up one year.
- Increased intake of base producing fruits and vegetables or supplementation with Na bicarbonate.

Fruits and vegetables were dosed to reduce dietary acid load by 50%

Conclusion:

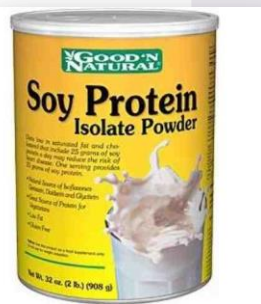
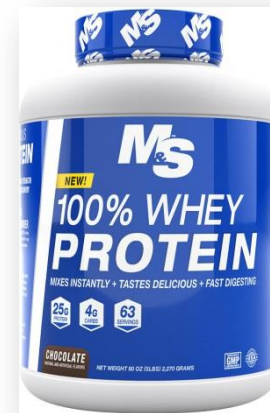
- Both treatments were able to improve metabolic acidosis and reduce kidney injury.
- Did not induce hyperkalemia

The leaky gut and altered microbiome in CKD

- CKD results in the disruption of intestinal epithelial barrier and profound changes in the gut microbial flora
- Indoxyl sulfate and p-Cresyl sulfate are the uremic toxins associated with chronic systemic inflammation and mortality
- Low K, low phosphorus diets
- Change in food substrate and altered composition of the microbiome.

Protein powder vs concentrate vs Isolate

		POWDER	CONCENTRATE	ISOLATE
SOY				
	protein	50%	70%	90%
WHEY				
	Protein	11% - 14.5%	25% - 89%	90%+
	Lactose	63% - 75%	10% - 55%	0.5%
	Milk fat	1% - 1.5%	2% - 10%	0.5%



CASE STUDY #2



59 year old female with CKD, colitis, HTN on hemodialysis.

Saw gastroenterologist for colitis who placed her on a modified vegetarian diet.

May: Labs: K 5.8 (2K bath) P 2.29 Albumin 40 PTH 173 URR 56%

Weight 57kg. Stable for a year.

On alfalcidol 1mcg 3 times a week. Tums 750mg tid

Occasionally eats eggs and shrimp. Relies on chickpeas, falafel, peanut butter, humus and beans for daily protein need.

Instructed on protein adequacy. Choose lower K fruit and vegetables.

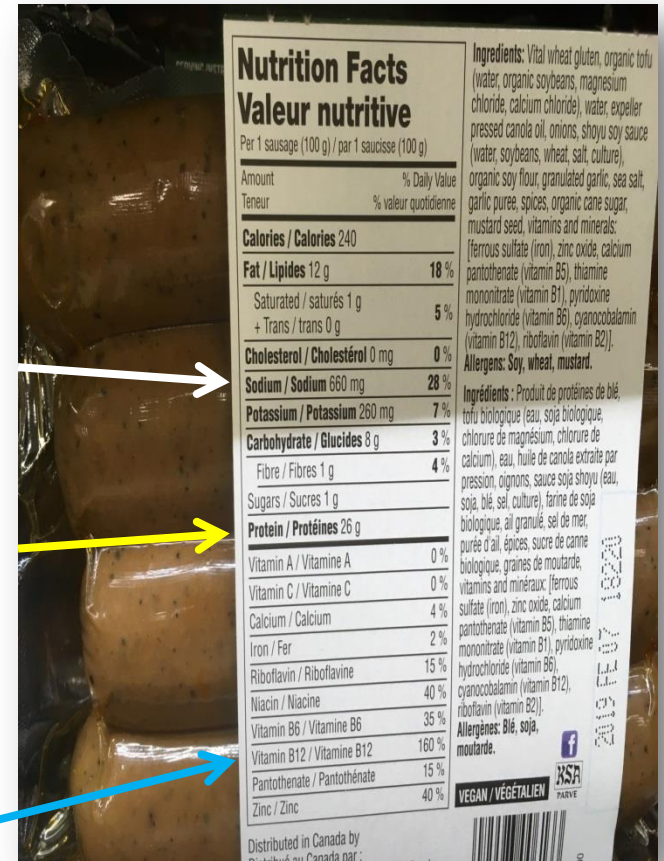
Follow up:

September: K is normal at 3.6. P 1.86 (2.03) Albumin 38

Weight is stable. Continues on modified vegetarian diet.

Vegetarian Diets and Sodium

- In general vegetarian diets are lower in sodium
- Meat analogs vary significantly in their Na content
- Product comparison and label reading to make better choices





What vegetarian dish can I prepare for Thanksgiving for my vegetarian guests that's not Tofurkey?

Examples of vegetarian options



- Often vegetarians replace the meat with textured vegetable protein, legumes, tofu, nuts, beans, vegan cheese or meat analogs
- Vegetarian lasagna, eggplant parmesan, black beans and rice, vegetarian chili, stir-fry with tofu or paneer, scrambled tofu, macaroni and cheese, paneer with rapini or peas, chickpea veggie burger, lentil meatballs on pasta with cashew sauce, pesto, falafel, edamame soybeans, quinoa salad/side

Minerals and vitamins of concern

Iron:

- Vegetarians have lower Fe stores
- Heme vs non-heme
- Physiological need, meal composition
- Bioavailability
- Presence of inhibitors vs enhancers

Minerals and vitamins of concern

Calcium:

- Lacto-ovo vegetarians meet or exceed requirement
Vegans may vary and fall below recommendations
placing them at risk for fractures
- Oxalate, phytate
- Calcium set Tofu, Fortified plant milks vs cow's milk

Minerals and vitamins of concern

Vitamin D:

- Low 25hydroxy vitamin D levels
- Fortified foods: Non dairy milks, fruit juices, margarine, some breakfast cereals
- Supplements: D2 (plant origin)
D3 (plant or animal)
- Active Vitamin D with lower kidney function

Minerals and vitamins of concern

Vitamin B12:

- Not a component of plant foods
- Fermented foods
- Fortified foods: twice per day
- Intrinsic factor for B12 absorption gets saturated

Minerals and vitamins of concern

Zinc:

- Adult vegetarians have zinc intake that are similar to or lower than non-vegetarians. Serum zinc levels are lower but within normal range.
- Overt zinc deficiency is not evident in western vegetarians
- Zinc sources: soy products, nuts and seeds, legumes and grains.

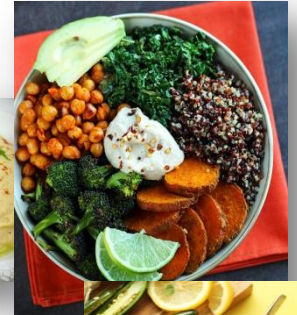
POLLING QUESTION 4:

What are your concerns in planning a vegetarian CKD diet?

- a. Protein adequacy
- b. Phosphorus
- c. Potassium
- d. Fitting in cultural preferences
- e. Assessing need for supplements
- f. Sodium from processed foods/meat analogs

Planning vegetarian renal diet

- Individualize meal pattern
- Understanding of cultural eating patterns
- Knowledge of and availability of meat analogs
- Nutrient content of milk substitutes and tofu
- Substitute lower K fruits and vegetables for higher K ones to accommodate legumes, nuts and seeds
- Monitor caloric intake for adequacy



Planning a vegetarian renal diet

- Include protein and calorie supplements if needed.
- Supplement vitamin B12, vitamin D, calcium, iron and zinc based on serum levels.
- Adjust dialysate K to maintain acceptable serum K level
- Adequate phosphate binding with meals and snacks. Educate patients to check the ingredient list on packaged foods for phosphorus additives
- Ensure dialysis prescription is adequate for urea clearance

To conclude.....

- Plant-based diets can be safely added to our patient's diets
- providing same quality protein as animal protein
- maintain nutritional status
- maintain P and K
- correct/improve metabolic acidosis
- plus additional benefits
- They offer many advantages to our patients in positively altering the course of kidney disease and preventing comorbid conditions

It is not necessary to become 100 %
vegetarian/vegan
but small changes
with one meal at a time,
with recipe support
are a step in the right direction.

Thank

You!



Dialysis Vegan Meal Plan

	Amount	Protein (g)	Phos (mg)
Soymilk	1 cup	7	120
Tofu	1 cup	20	240
Legumes	½ cup	8	130
Nuts and seeds	1oz	6	140
Peanut butter	2 Tbsp	8	130
Meat analog	1	8	90
Starch	7	14	245
Fruit	3	3	45
Vegetables	3	3	75
Fats	6		30
Hi Calorie	3		45
		77g	1305mg

Pre-Dialysis Vegan Meal Plan

	Amount	Protein (g)	Phos (mg)
Soymilk	1cup	7	120
Tofu	½ cup	10	120
Legumes	½ cup	8	130
Nuts and seeds			
Peanut butter			
Meat analog	1	8	90
Starch	5	10	175
Fruit	3	3	45
Vegetables	3	3	75
Fats	8		40
Hi Calorie			
		49	795

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