Saudi J Kidney Dis Transpl 2021;32(3):786-793

Saudi Journal of Kidney Diseases and Transplantation

Brief Communication

Recipe Development for the Kidney Patient

Gul Akduman[1], Fatma Esra Gunes[2]

[1]Department of Nutrition and Dietetic, Faculty of Health Science, Marmara University, Istanbul, Turkey, [2]Department of Nutrition and Dietetic, Faculty of Health Science, Medeniyet University, Istanbul, Turkey

ABSTRACT. Kidney patients are restricted from sodium, potassium, phosphorus, and protein. In thisstudy, new recipes have been developed in order to prevent the decrease in appetite, to control the loss of liquid electrolytes due to vomiting, to help patients feel better by improving their morale, to facilitate their adaptation to the diet. Eight selected foods were prepared by modified for reducing sodium, potassium, and phosphorus (repeating 2 times) and by standard recipes (repeating two times). Eight foods and 16 recipes were obtained. Sodium, potassium, phosphorus, and protein contents were measured after the process. Sodium, potassium, and phosphorus contents were analyzed with the ICP-MS method. Protein content was analyzed with the Kjeldahl nitrogen determination method. Applied cooking methods led to a decrease in sodium, potassium, phosphorus, and protein levels in the modified foods. The highest loss rate (65.3%) was observed in proteins in apple halva. The lowest loss (21.5%) was determined in the potassium in the banana cake. These cooking methods can be useful for enriching the meals of kidney patients.

Introduction

Chronic kidney disease (CKD) is associated with age-related renal function regression that accelerates in hypertension, diabetes, obesity, cardiovascular diseases, and primary renal disorders.[1] It is defined as abnormalities in kidney function or structure that are affected negatively health and present for more than three months.

Correspondence to:

Ms. Gul Akduman,
Department of Nutrition and Dietetic,
Faculty of Health Science,
Marmara University, Istanbul, Turkey.
E-mail: gul.ogren@marmara.edu.tr

Included participants fulfilled the following criteria: (1) people with markers of kidney damage (2) without markers of kidney damages, people with a glomerular filtration rate of <60 mL/min/1.73 m^2 on at least two times by a period of at least 90 days.[2]

Treatment of CKD can be examined in two groups as preventive treatment and renal replacement therapy. Preventive treatment is important for decelerating disease progression, especially for patients not in the terminal period. Control of hypertension, treatment of anemia and renal osteodystrophy, and also modification of diet are important factors for preventive treatment.[3,4] CKD Epidemiology Collaboration indicates that diet modifications in kidney disease decrease clinical risk regardless

of factors such as age, race, and gender.[5] The main purpose of nutritional therapy; providing adequate food consumption, minimizing protein catabolism, alleviating uremic symptoms, preventing malnutrition, regulating appetite, maintaining optimum body weight, keeping biochemical parameters at optimum values.[6,7]

It is known that the adaptation to the diet of kidney patients is low. In a study, diet incompatibility was detected in 70% of patients.[8] In another study, it was noted that the energy and protein intake levels of kidney patients were lower than the recommended value.[9] Adverse changes in fluid-electrolyte balance (hyperkalemia, hyperphosphatemia, peripheral and pulmonary edema) may occur in patients who do not follow their diet.[10] Inadequate intake, losses, metabolic and endocrine disorders, increased protein catabolism are some of the common causes of nutritional problems in these patients.[11] Dietary incompatibility negatively affects patients' mortality and morbidity rates.[8]

Products for the use of patients with CKD have been developed and marketed to regulate the meals of these patients. In this study, new recipes have been developed in order to prevent the decrease in appetite, to control the loss of liquid electrolytes due to vomiting, to help patients feel better by improving their morale, to facilitate their adaptation to the diet.

Materials and Methods

Preparation of recipes

In order to prepare the recipes which are alternatives to routinely consumed food, Sabahattin Zaim University Nutrition and Dietetics Department Food Preparation Laboratory was used. The quantities of each of the using materials are recorded. The methods used to reduce the sodium, potassium, phosphorus minerals, and protein in the new recipes were recorded by coding separately for each recipe (Table 1). Modified recipes for consumption [(with the reduction process of protein, sodium, potassium, phosphorus) (8 food and 16 recipes)] and standard recommended recipes [(without the reduction process of protein, sodium, potassium, phosphorus) (8 food and 16 recipes)] were prepared for chronic kidney patients. Also, low-protein commercial ready-made products (flour, pasta, noodles) were used in some recipes. Recipes' development stages are summarized below:

Step 1 (Selection of original recipes): Foods that are rich in sodium, potassium, phosphorus, and protein and likely to be frequently consumed during the day have been selected. In the meeting held before the study, recipe preparation methods to be followed during the data collection were determined. As a result of the interviews, it was decided to prepare eight recipes for two times (Noodle soup with lentils, boiled meat, split aubergines (with meat filling), boiled vegetables, green beans with olive oil, flat bread (baked on a griddle), banana cake, apple halva). Recipes were applied as included in the Standard Recipes book.

Step 2 (Making the recipe suitable for the kidney diet): To facilitate the consumption of meals in the original recipe in the diet of kidney patients were applied to certain procedures on the recipes. These; Reducing the portion size, removing all added table salt (NaCl), applying the various cooking and preparing (boiling, peeling, etc.) methods, reducing the contents of protein by eliminating protein-rich foods or using special products with low protein, reducing sodium, potassium and phosphorus contents by reducing or removing sodium-rich, potassium-rich, and phosphorus-rich foods (The method applied for each recipe is given in Table 1).

Step 3 (Preparation of the adapted recipe): After the provision of the necessary funds by the TUBITAK-2209b, the selected eight recipes were prepared two times and then were reported.

Analysis of sodium, potassium, phosphorus, and protein in recipes

The recipes that are recommended as a standard for patients with CKD and are applied the process to facilitate their consumption were analyzed by a team specialized in the field at

Table 1. Applied methods to reduce the levels of sodium,ptassium, phosphorous and protein.

Recipes	Process								
	Waiting in coldwater	**Pouring water**	**Peeling**	**Chopping**	**Boiling**	**Pouring water**	**Reboiling**	**Pouring water**	**Using commercial product**
Noodle soup with lentils					√ (1)	√ (2)			√ (3)
Boiledmeat	√ (2)	√ (3)		√ (1)	√ (4)				
Split aubergines (with meat filling)									
Meat	√ (1)	√ (2)			√ (3)				
Aubergines			√ (1)		√ (2)				
Boiled vegetables					√ (1)	√ (2)	√ (3)	√ (4)	
Green beans with oliveoil				√ (1)	√ (2)	√ (3)	√ (4)	√ (5)	
Flatbread (baked on a griddle)									√ (1)
Banana cake	√ (2)		√ (1)		√ (3)	√ (4)			√ (5)
Apple halva			√ (1)	√ (2)	√ (3)	√ (4)			

Brackets indicate the order of processing.

the Istanbul Sabahattin Zaim University Food Analysis Laboratory. Sodium, potassium, and phosphorus contents were analyzed with the ICP-MS method. Protein content was analyzed with the Kjeldahl nitrogen determination method.[12,13]

Results

The means of sodium, potassium, phosphorus, and protein contents of the recipes prepared by standard and modified methods are shown in Table 2. Sodium, potassium, phosphorus, and protein contents decreased after the process. The highest loss rate in the sodium content was 59% in modified boiled vegetables) and the lowest loss rate was 45.8% (in modified noodle soup with lentils). The highest loss rate in the potassium content was 53.1% (in modified boiled vegetables) and the lowest loss rate was 21.5% (in modified banana cake). The highest loss rate in the phosphorus content was 58.9% (in modified flat brad) and the lowest loss rate was 36.4% (in modified noodle soup with lentils). The highest loss rate in the protein content was 75% (in modified boiled vegetables) and the lowest loss rate was 42.4% (in modified banana cake). Sodium, potassium, and protein loss in boiled vegetables were higher than in other foods.

Discussion

In this study, new recipes have been developed in order to prevent the decrease in appetite, to control the loss of liquid electrolytes due to vomiting, to help patients feel better by improving their morale, to facilitate their adaptation to the diet. In the studies, it was emphasized that patients with CKD have a poor quality of life compared to the control group and more studies are needed to improve it.[14,15]

Many studies were found that dietary restrictions of sodium, potassium, and phosphorus have been improved the biochemical parameters of chronic kidney patients and their quality of life.[16] It is recommended that patients with CKD reduce their daily sodium intake (below 2000 mg/90 mmol daily).[17] Salt intake widely varies across countries, but it is often seen that individuals exceed the recommended amount in most communities.[18] Healthy people take 1425–2070 mg/day phosphorus, this varies according to their geographical regions. However, dialysis patients should limit their phosphorus intake to 800–1000 mg/day to prevent hyperphosphatemia.[19] High protein food contains more phosphorus. Milk, meat, cereal, fish are the main sources of phosphorus. It is well known that reducing both protein and phos-phorus may have beneficial effects on CKD.[20]

In a study, to reduce the potassium content of vegetables, the vegetables are sliced and kept in water for the previous night, and then the vegetables are put in new water and boiled.[21] In this study, a similar method was applied and the green beans selected from the vegetable group were boiled without meat. As a result of the process, it was found that there was a loss of sodium 52.3%, loss of potassium 31%, loss of phosphorus 47.5%, and loss of protein 60.3% in modified green beans with olive oil. Another method for reducing the potassium content is immersion in cold deionized water. In a study, the potassium content of a kind of green banana called “matooke” was examined at different time intervals (2, 4, 6, 8, 12, and 24 h) using this method. In each of these time intervals, the amounts of potassium in boiling water and in boiled matooke were determined. As a result of this, it was detected that there is a relationship between the wetting time and potassium loss of the matooke samples which are kept in water. However, there wasn't found any relationship between K^+ loss and wetting time. According to the result of that study, it has been determined that the potassium level of Matooke decreases after the boiled for 60 min while the potassium level of boiling water increases. This indicates that the potassium in the banana is passed to the boiling water. In addition, the effect of baking on the potassium level of banana was examined. When baking at 200°C for 60 min, it was determined the potassium in matooke is reduced more than other degrees and durations.[22] In the current

Table 2. Mean of sodium, potassium, phosphorus and protein contents of all recipes.

Recipes	Sodium			Potassium			Phosphorus			Protein		
	Process		Loss (%)	Process		Loss (%)	Process		Loss (%)	Process		Loss (%)
	Standard (mg/100 g)	Modified (mg/100 g)		Standard (mg/100 g)	Modified (mg/100 g)		Standard (mg/100 g)	Modified (mg/100 g)		Standard (mg/100 g)	Modified (mg/100 g)	
Noodle soup with lentils	226.8	123.0	45.8	204.2	133.7	34.6	39.6	25.2	36.4	10.2	5.4	47.1
Boiled meat	299.0	135.0	54.9	211.7	109.1	48.5	72.4	30.5	57.9	22.3	12.5	44.0
Split aubergines (with meat filling)	271.2	122.4	54.9	311.5	158.1	49.3	48.5	28.3	41.7	8.1	3.2	60.5
Boiled vegetables	98.6	40.5	59.0	290.2	136.3	53.1	20.3	10.0	50.8	0.8	0.2	75.0
Green beans with olive oil	110.2	52.6	52.3	195.8	135.2	31.0	31.8	16.7	47.5	7.8	3.1	60.3
Flatbread (baked on a griddle)	188.5	87.6	53.6	183.3	88.2	51.9	58.5	24.1	58.9	8.6	3.0	65.2
Banana cake	130.4	59.5	54.4	187.5	147.3	21.5	43.1	20.4	52.7	7.8	4.5	42.4
Apple halva	90.4	48.7	46.2	132.2	71.9	45.7	24.1	10.7	55.7	2.3	0.8	65.3

Two recipes were prepared from each recipe. And the mean values of sodium, potassium, phosphorus and protein were recorded.

study, we used a similar method (peeling, waiting in cold water, boiling). Sodium, potassium, phosphorus, and protein loss in the modified banana cake were 54.4%, 21.5%, 52.7%, and 42%, respectively. Additionally, peeling, cutting into small pieces, and wetting overnight are among the methods used for reducing the potassium. However, in a study by Beto et al, it is emphasized that the wetting process is not necessary. They obtained more effective results by boiling potatoes which are chopped into small pieces and peeled.[23] In a study by Bethke and Jansky, it has been shown that there is a large decrease in potassium levels by boiling thinly sliced potatoes and it is not necessary to complicate the process by wetting the tuber slices in water before boiling.[24] In the current study, the modified boiling vegetable recipe was prepared by a similar method. Sodium, potassium, phosphorus and protein loss ratios were found to be 58, 86%, 53, 01%, 50, 63%, 73, 03%, respectively.

In a study, it was found that fermented rice has two times higher protein and phosphorus content than boiled rice.[25] Vrdoljak et al evaluated the effect of various types of heat treatment [boiling in water (at 100°C), cooking in steam (at 100°C), frying in oil (at 170°C and 180°C), or cooking in water added oil (100°C)] on dry matter, protein, calcium and phosphorus content in nine different food [potatoes, carrots (fresh and frozen), green beans (frozen), chicken, beef, pork, fish (frozen), rice and pasta]. Some of the types of heat treatment have significantly reduced the phosphorus content of various foodstuffs; 27%–43% in fresh and frozen vegetables, 10%–49% in meat, 7% in pasta, and 22.8% in rice. The phosphorus content of heat-treated chicken and beef meat was much lower than raw meat. It has been concluded that the boiling of meat can be decreased protein and especially phosphorus content. In addition, meats were wetted in the cold water for 1 h before starting the heat treatment. Then, it was detected the phosphorus content of meat further decreased. Boiling in water and cooking in our own water with low-fat significantly decreased the phosphorus content without affecting the protein content. As a result, these two methods are the most efficient heat treatment to minimize the phosphorus content of food stuffs.[19] In the current study, fermented nutrients were not used. Boiled meat was prepared by using similar methods. The sodium, potassium, phosphorus, and protein contents of the modified recipe were lower than standard recipes (percentages of loss were 54.9%, 48.5%, 41.7%, 60.5%, respectively).

Compared to the standard recipe, sodium, potassium, phosphorus, and protein loss were detected as 54.9%, 49.3%, 41.7%, and 60.5%, respectively in modified split aubergines. Modified lentil noodle soup prepared in the same way contained 45.8% lower sodium, 34.6% lower potassium, 25.2% lower phosphorus, and 47.1% lower protein. In the flat bread prepared by a similar method, the sodium loss was 53.6%, the potassium loss was 51.9%, the phosphorus loss was 58.9%, and the protein loss was 65.2%. Also, in the apple halva prepared by a similar method, the sodium loss was 46.2%, the potassium loss was 45.7%, the phosphorus loss was 55.7%, and the protein loss was 65.3%.

Limitations

The methods applied to reduce the mineral and protein levels were tried only in eight foods and the organo leptic characteristics of the recipes were not been evaluated. Methods used for recipes should be studied on more nutrients. Strengths of this study; in the literature, there is no study to reduce the limited use of nutrients (sodium, potassium, phosphorus, and protein) that kidney patients frequently use in their daily lives. In the current study, it has been studied foods that kidney patients can use frequently in daily life but they are not often used due to the restriction of these foods. Patients can provide a variety of diets in their daily nutrition by using these cooking methods.

In conclusion, in this study, the methods in the literature have been applied to different recipes in order to decrease the sodium,

potassium, and phosphorus, and protein contents. The applied procedures have ensured that the amount of these minerals and protein is lower than standard recipes. These methods are considered to be feasible in order to facilitate the dietary adaptation of chronic kidney patients and to enrich their daily menus.

Conflict of interest: None declared.

References

1. Chawla LS, Eggers PW, Star RA, Kimmel PL. Acute kidney injury and chronic kidney disease as interconnected syndromes. N Engl J Med 2014;371:58-66.
2. NICE. CG182 Chronic Kidney Disease in Adults: Assessment and Management. Available from: http://guidance.nice.org.uk/CG73/Guidance/pdf/English. [Last accessed on July 3, 2014.
3. Türker PF, Gümüş B. Nutritional support in end-stage renal disease. Bes Diy Der 2013;41: 258-65.
4. Lim VS, Kopple JD. Protein metabolism in patients with chronic renal failure: Role of uremia and dialysis. Kidney Int 2000;58:1-10.
5. Matsushita K, Tonelli M, Lloyd A, et al. Clinical risk implications of the CKD Epidemiology Collaboration (CKD-EPI) equation compared with the Modification of Diet in Renal Disease (MDRD) study equation for estimated GFR. Am J Kidney Dis 2012; 60:241-9.
6. James MT, Hemmelgarn BR, Tonelli M. Early recognition and prevention of chronic kidney disease. Lancet 2010;375:1296-309.
7. Levey AS, Coresh J. Chronic kidney disease. Lancet 2012;379:165-80.
8. Günalay S, Taşkıran E, Mergen H. Evaluation of dietary and fluid restriction non-adherence in patients on hemodialysis. FNG Bilim Tıp Dergisi 2017;3:9-14.
9. Çelik ZM, İslamoğlu AH, Akduman G, Güneş FE. Investigation of nutritional status of hemodialysis patients in Istanbul/Turkey. Adv J Urol Nephrol 2019;1:1-5.
10. Tufan F, Yıldız A, Dogan I, Yıldız D, Sevinir Ş. Urea to creatinine ratio: A forgotten marker of poor nutritional state in patients undergoing hemodialysis treatment. Aging Male 2015;18: 49-53.
11. Altıparmak MR. Nutrition in hemodialysis. Turk Klinikleri J Nephrol Spec Top 2015;8:53-60.
12. Lum TS, Leung KS. Strategies to overcome spectral interference in ICP-MS detection. J Anal At Spectrom 2016;31:1078-88.
13. Kjeldahl C. A new method for the determination of nitrogen in organic matter. Z Anal Chem 1883;22:366.
14. Brown MA, Collett GK, Josland EA, Foote C, Li Q, Brennan FP. CKD in elderly patients managed without dialysis: Survival, symptoms, and quality of life. Clin J Am Soc Nephrol 2015;10:260-8.
15. Akyol Durmaz A. Quality of life in kidney failured patients. Turk Klinikleri J Intern Med Nurs Spec Top 2017;3:162-70.
16. Gerasimoula K, Lefkothea L, Maria L, Victoria A, Paraskevi T, Maria P. Quality of life in hemodialysis patients. Mater Sociomed 2015;27:305-9.
17. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Suppl 2013;3:1-150.
18. Humalda JK, Navis G. Dietary sodium restriction: A neglected therapeutic opportunity in chronic kidney disease. Curr Opin Nephrol Hypertens 2014;23:533-40.
19. Vrdoljak I, Panjkota Krbavcic I, Bituh M, Vrdoljak T, Dujmic Z. Analysis of different thermal processing methods of food stuffs to optimize protein, calcium, and phosphorus content for dialysis patients. J Ren Nutr 2015; 25:308-15.
20. Chang AR, Anderson C. Dietary phosphorus intake and the kidney. Annu Rev Nutr 2017; 37:321-46.
21. NKDEP. Chronic Kidney Disease (CKD) and Diet: Assesment, Managemet and Treatment. An Overview Guide for Dietitians. USA: National Kidney Disease Educational Program; 2015.
22. Asiimwe J, Sembajwe LF, Senoga A, Bakiika E, Muwonge H, Kalyesubula R. Overnight soaking or boiling of "Matooke" to reduce potassium content for patients with chronic kidney disease: Does it really work? Afr Health Sci 2013;13:546-50.
23. Beto JA, Schury KA, Bansal VK. Strategies to promote adherence to nutritional advice in patients with chronic kidney disease: A narrative review and commentary. Int J

Nephrol Renovasc Dis 2016;9:21-33.
24. Bethke PC, Jansky SH. The effects of boiling and leaching on the content of potassium and other minerals in potatoes. J Food Sci 2008; 73:H80-5.
25. Nicolau A, Georgescu L, Bolocan A. Impact of bio-processing on rice. Ann Univ Dunarea Jos Galati 2011;35:19.