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Potassium Analysis of Cooking Water and Selected Vegetables Before and After Leaching by Different Cooking Methods

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ABSTRACT

The study aims to compare the potassium content of different types of cooking water (bore well, metro water and mineral water) and potassium rich vegetables (potato, yam, spinach and Amaranth gangeticus) before and after leaching by different cooking methods. The results illustrate that potassium content of the selected vegetables reduced significantly after leaching by different cooking methods. Maximum leaching of potassium from potato (75%) and yam (75%) was reported in pressure cooking. Maximum leaching of potassium from spinach (64%) and Amaranth gangeticus (87%) was reported in soaking and cooking method. Thus it is evident that processing vegetables by leaching removes potassium to such an extent it adds variety to the monotonous diet and makes most of the vegetables suitable for the dietetic management of the kidney disease.

INTRODUCTION

Food is the basic necessity of life which satisfies the physiological and social needs of human being. The nutritional approach which has dominated in most of the research works on food consumption views food and eating in relation to the nutrient composition of foods and their instrumental roles in the physiologic functioning of the human body (Shils, 2006).

Vegetables form an essential part of the diet of both rich and the poor as majority of the Indian population is vegetarian (Bedi. R et al., 2006). In India a substantial proportion of the population, perhaps approximately 35%, follows a traditional vegetarian diet for many generations (Refsum. H et al., 2001). Vegetables are the major source of vitamins and minerals which are the chief regulators in metabolism in human beings (Shahnaz et al., 2003).

Minerals are an important part of a healthy diet. Some minerals are necessary for human life and play very important roles in bodily functions. Nutrition professionals recommend that they should be consumed as part of a balanced diet, primarily as fruits and vegetables, rather than in the form of dietary supplements (Piotr Szefer and Jerome, 2007). Losses of vitamins and minerals during processing and cooking can occur either due to oxidation or by dissolving in water (Tapadia et al., 1995). One of the six general classes or kinds of nutrients found in all foods is water. Waterborne minerals are in ionic form and are easily absorbed by the gastrointestinal tract, it has been suggested that drinking water may be an important source of mineral intake (Arik et al., 2001).

Potassium is a mineral involved in electrical and cellular body function. Elevated potassium is of special concern for patients with chronic kidney disease. In people with end stage renal disease high potassium foods must be limited so that potassium levels do not get too high and cause complications. Restricting potassium rich foods lead to reduced intake of fruits and vegetables leaving meat and fats as the main source of calories (Kamyar Kalantar et al., 2002). Evidence show that preparing vegetables by leaching removes potassium to such an extent it adds variety to the monotonous diet and makes most of the vegetables suitable for the dietetic management of the kidney disease.

Hyperkalemia is a potentially life threatening situation as it can cause respiratory failure due to muscle weakness and sudden cardiac arrest. So in all chronic kidney disease patients with hyperkalemia a strict attention to potassium in the diet is required. Alternative choices should be provided either to limit foods that are high in potassium or to remove potassium from potato and other tuberous vegetables. Health care providers should be a food coach in balancing mineral restriction of patient while also trying to make them follow dietary guidelines for other medical conditions (John T. Daugirdas, 2011). If patients want to include some high potassium vegetable in their diet, leaching is recommended before using high potassium rich foods. The dietitians will be able to counsel on the amount of leached high potassium vegetables that can be safely included in the diet (National Kidney foundation, 2012). Renal dietetics practice centered on the multiple aspects of patient care, and wellness has developed during the recent times (Mary Kay Hensley, 2008).

Data relating to potassium and other minerals present in potatoes and other vegetables cut in to various sizes before leaching and boiling are lacking. In an effort to increase variety, flexibility and compliance to the nutritional protocols for chronic kidney disease patients, this study investigates ways to optimize leaching of potassium from fresh vegetables. Studying the effect of leaching potassium from vegetables by different cooking methods will provide guidance to nutritionists developing diets and advise patients with compromised renal function on various ways to reduce potassium consumption.

MATERIALS AND METHODS

The present study involves pre-test post-test experimental design for estimating the potassium content of cooking water like bore well water, metro water and mineral water and potassium rich vegetables like potato, yam, spinach and Amaranth gangeticus before and after leaching by various cooking methods like soaking and cooking, normal cooking, double cooking, pressure cooking and microwave cooking. The different types of cooking water were analyzed for potassium content to see if the potassium content present in the water affects the leaching of potassium rich vegetables. 500 ml of all the water samples and 100g of all the raw vegetable samples were given for potassium analysis before cooking.

Processing methods

100g of each vegetable were weighed and taken for each cooking method. The samples of raw vegetables namely potato and yam were peeled and cut in to evenly cube sized pieces. The green leafy vegetables were washed, cleaned and chopped evenly for processing. Metro water was selected for each processing method. For the soaking and cooking method the selected cut vegetables were soaked in hot water (50–60 C) overnight for 8 hours in 1:5 ratio (100g vegetables: 500ml of water). The soaked water was discarded and the vegetables were cooked for 10 minutes by sprinkling minimal amount of water. For the normal cooking and double cooking 100g of cut vegetables were added to the boiling water (100 C) and cooked for 10 minutes. In case of double cooking the same procedure was repeated again. For pressure cooking the vegetables were pressure cooked for 2 to 3 minutes with the same ratio of vegetable and water. The same ratio of each vegetable with water was cooked in microwave at 95 ± 2 C for 10 minutes. After cooking the water was discarded from all the samples and 100ml of each leached water samples and 100g of leached vegetables were given for

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potassium analysis. The amount of potassium leached out in to the cooking water from the potassium rich vegetables and the potassium content of the vegetables after leaching was measured using atomic absorption spectrophotometry. The analysis was carried out by qualified analyst in the laboratory attached to A to Z pharmaceuticals, Chennai.

The data collected were analyzed using statistical methods like arithmetic mean, standard deviation and student't' test.

RESULTS & DISCUSSION

Potassium analysis of water show only traces of potassium in all the water sample with bore well water 14.86 mg/100 ml, metro water 8.83 mg/100 ml and mineral water 0.24 mg/100 ml. Metro water was used for all the cooking and leaching processes as it is the main water source supplied to people by Chennai Metro water Supply and Sewerage Board (Chandrakumar and Mukundan, 2006). The present result correlates with the findings of Azrina Azlan et al., 2012, during their studied on the evaluation of minerals content of drinking water in Malaysia.

Table – 1: Comparison of potassium content of potato, yam and cooking water before and after leaching by different cooking methods

Cooking methods	Potato mg/100g Water mg/100ml	Potassium		't' value
		before leaching	after leaching	
		Mean ± SD	Mean ± SD	
Soaking and cooking	Potato	259.83 ± 3.16	171.11 ± 1.13	86.43**
	Metro Water	8.83 ± 0.07	87.15 ± 0.09	1900.20**
' Normal cooking	Potato	259.83 ± 3.16	94.08 ± 1.57	94.27**
	Metro Water	8.83 ± 0.07	153.70 ± 1.59	202.93**
Double cooking	Potato	259.83 ± 3.16	84.52 ± 1.92	295.59**
	Metro Water	8.83 ± 0.07	46.72 ± 1.61	54.273**
Pressure cooking	Potato	259.83 ± 3.16	65.75 ± 3.62	67.58**
	Metro Water	8.83 ± 0.07	155.72 ± 1.34	252.25**
Microwave Cooking	Potato	259.83 ± 3.16	81.69 ± 1.23	174.46**
	Metro Water	8.83 ± 0.07	119.39 ± 1.57	162.69**
Cooking methods	Yam mg/100g Water mg/100ml	before leaching	after leaching	't' value
		Mean ± SD	Mean ± SD	
Soaking and cooking	Yam	217.13 ± 1.70	153.64 ± 1.888	40.876**
	Metro Water	8.83 ± 0.07	67.37 ± 1.668	81.057**
Normal cooking	Yam	217.13 ± 1.70	88.60 ± 0.40	170.99**
	Metro Water	8.83 ± 0.07	138.50 ± 0.23	1111.66**
Double cooking	Yam	217.13 ± 1.70	74.70 ± 1.61	115.87**
	Metro Water	8.83 ± 0.07	86.33 ± 1.15	158.55**
Pressure cooking	Yam	217.13 ± 1.70	54.79 ± 1.72	153.160**
	Metro Water	8.83 ± 0.07	136.06 ± 1.20	244.667**
Microwave Cooking	Yam	217.13 ± 1.70	70.47 ± 1.41	141.816**
	Metro Water	8.83 ± 0.07	108.61 ± 1.61	142.561**

** - Significant at 1 % level

It was apparent from table 1 that during pressure cooking of potato and yam, the potassium content after leaching reduced significantly from 259.83 mg/100g to 65.75 mg/100g and 217.13 mg/100g to 54.79 mg/100g respectively compared to other cooking methods ($p<0.01\%$). The least percentage loss of potassium for potato (35%) and yam (29%) was reported after leaching by soaking and cooking ($p<0.01\%$).

The findings of the present study revealed that pressure cooking drained 75% of potassium from potato and yam compared to other cooking methods, this results correlate with the findings of Bethke and Jansky (2008) during their studies on the effects of boiling and leaching on the potassium content and other minerals in potatoes and also with the findings of Ihsanullah Daur et al., 2008 who showed that Pressure-cooking of chick pea drained most of the minerals from seeds except calcium.

Table – 2: Comparison of potassium content of spinach, Amaranth gangeticus and cooking water before and after leaching by different cooking methods

Cooking methods	Spinach mg/100g Water mg/100ml	Potassium		't' value
		Before leaching	After leaching	
		Mean ± SD	Mean ± SD	
Soaking and cooking	Spinach	171.69 ± 1.72	61.10 ± 0.67	156.303**
	Metro Water	8.83 ± 0.07	108.56 ± 1.28	181.145**
Normal cooking	Spinach	171.69 ± 1.72	94.18 ± 1.61	110.126**
	Metro Water	8.83 ± 0.07	77.50 ± 1.17	135.512**
Double cooking	Spinach	171.69 ± 1.72	72.07 ± 0.79	158.669**
	Metro Water	8.83 ± 0.07	76.16 ± 1.16	133.79**
Pressure cooking	Spinach	171.69 ± 1.72	91.37± 0.44	84.349**
	Metro Water	8.83 ± 0.07	53.90 ± 0.48	206.80**
Microwave Cooking	Spinach	171.69 ± 1.72	136.49 ± 1.43	40.831**
	Metro Water	8.83 ± 0.07	31.62 ± 1.40	36.43**

Cooking methods	Amaranth gangeticus (GLV) mg/100g Water mg/100ml	Before leaching	After leaching	't' value
		Mean ± SD	Mean ± SD	
Soaking and cooking	GLV	245.31 ± 0.82	30.55 ± 1.55	371.21**
	Metro Water	8.83 ± 0.07	196.41 ± 1.19	363.24**
Normal cooking	GLV	245.31 ± 0.82	67.42 ± 1.65	201.80**
	Metro Water	8.83 ± 0.07	159.89 ± 1.59	220.05**
Double cooking	GLV	245.31 ± 0.82	48.98 ± 1.05	522.97**
	Metro Water	8.83 ± 0.07	113.12 ± 0.08	2002.85**
Pressure cooking	GLV	245.31 ± 0.82	64.47 ± 1.66	302.60**
	Metro Water	8.83 ± 0.07	98.96 ± 1.01	211.51**
Microwave Cooking	GLV	245.31 ± 0.82	94.18 ± 1.60	186.29**
	Metro Water	8.83 ± 0.07	86.01 ± 1.14	155.16**

**- Significant at 1 % level

It was evident from table 2 that during soaking and cooking of spinach and Amaranth gangeticus, the potassium content after leaching reduced significantly from 171.69 mg/100g to 61.10 mg/100g and 245.31 mg/100g to 30.55 mg/100g respectively compared to other cooking methods ($p<0.01\%$). The least percentage loss of potassium for spinach (21%) and Amaranth gangeticus (62%) after leaching was reported in microwave cooking ($p<0.01\%$).

The present study clearly indicates that potassium leaching from Amaranth gangeticus after microwave cooking was lesser compared to other cooking methods, this result is in agreement with the findings of Saleh and Tarek (2002) who illustrated that the losses of vitamins and minerals in chickpeas cooked by microwaving were smaller than those cooked by boiling and autoclaving.

The results of potassium analysis in water samples clearly indicates that there is a significant ($p<0.01\%$) increase in the potassium content of the water after leaching of all the vegetables by different cooking methods, this is in concord with the findings of Isabelle Lestienne et al., 2005, who demonstrated that soaking whole seeds for 24 hours led to leaching of iron and zinc ions in to the soaking medium.

CONCLUSION

Controlled intake of potassium is important to prevent complications such as cardiac arrhythmia and sudden death in the nutritional management of chronic kidney disease (Herselman. M. G et al., 2005). The highest percentage loss of potassium in potato (75%) and yam (75%) was recorded after leaching by pressure cooking ($p<0.01\%$), similarly for spinach 64% loss and Amaranth gangeticus 87% loss was reported after leaching by soaking and cooking ($p<0.01\%$). There can be a possible loss of vitamins in the vegetables while leaching, but vitamins are usually prescribed as a medicinal supplement for renal patients, the benefits of low potassium content outweigh possible loss of vitamins in vegetables after leaching.

It can be concluded that among various cooking methods pressure coking was the most effective method in leaching potassium from the tubers and soaking was the most effective method in leaching green leafy vegetables. Thus it is evident that preparing vegetables by leaching removes potassium to such an extent it adds variety to the monotonous diet and makes most of the vegetables suitable for the dietetic management of the kidney disease.

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