Volume : 2 | Issue : 2 | Feb 2013 • ISSN No 2277 - 8160

Research Paper | Home Science

# Analysis of Selected Micronutrients Before and After Leaching of Potato and Yam Processed By Different Cooking Methods

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**ABSTRACT**

*The study aims to study the effect of different cooking methods soaking and cooking, normal cooking, double cooking, pressure cooking and microwave cooking on the iron, thiamine, riboflavin, niacin, ascorbic acid and folic acid content of potato and yam before and after leaching. The results clearly indicated that among various cooking methods soaking and cooking was the most effective method in retaining iron (98%), thiamine (91%), riboflavin (75%), niacin (77%), ascorbic acid (99%) and folic acid (93%) in potato, similarly in retaining iron (99.8%), thiamine (94%), riboflavin (85.5%) and folic acid (97%) in yam. Maximum retention of niacin (100%) and ascorbic acid (98%) in yam was observed during microwave cooking. Leaching of vegetables is recommended to renal patients in order to reduce the food mineral load. The results of the study will provide guidance to nutritionists regarding the effectiveness in advising patients with compromised renal function on the importance of leaching vegetables.*

**KEYWORDS: Leaching of vegetables, potato, yam**

## INTRODUCTION

Food is the basic necessity of life which satisfies the physiological and social needs of human beings. 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 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). Vitamins are essential part of foods and feeds. Humans and animals require a certain amount of vitamins for normal health (Mian, Muhammad Asif and Rashida Ali, 2009).

Roots and tubers refer to any growing plant that stores edible material in subterranean root and tuber. The most popular of this food group are Cassava, Yam, Cocoyam, Irish and Sweet potatoes. Roots and tubers are not rich sources of fat soluble vitamins. Vitamin C occur in appreciable amounts in several root crops and when correctly prepared can make a significant contribution to the vitamin C content of the diet. Most of the root crops contain small amounts of vitamin B group sufficient to supplement normal dietary sources (Ugwu. F. M, 2009).

Cooking is an essential process for vegetables not only to make them edible but also for enabling maximum utilization of the starch present in the vegetables as a source of energy (Kala and Prakash, 2001). Losses of vitamins and minerals during processing and cooking can occur either due to oxidation or by dissolving in water (Tapadia et al., 1995). The degree of vitamins and other nutrient losses is influenced by various factors, for example the type of food, variety of vegetables, the way of cutting, preparation, duration and method of cooking (Rumm-Kreuter D et al., 1990).

Arunachalam Kala and his co-worker in 2006 who evaluated the nutrient composition of four vegetables suggested that ascorbic acid was destroyed to the greatest extent by pressure cooking followed by microwave cooking and conventional method. Mineral content of the vegetables did not differ significantly in raw and cooked vegetables. Santosh et al., 2010 recommend that microwave cooking could be the best method for legume preparation, not only for improving nutritional quality, but also for reducing the cooking time. With respect to the whole soaking and cooking processes, the best conditions, which result in minimum vitamin loss, are 9 hours of soaking in 0.1% citric acid solution or in water and subsequent microwave cooking of the seeds. These conditions are found to be optimal for best retention of other nutrients as well.

Leaching of vegetables is recommended to renal patients in order to reduce the food mineral load. The effect of cooking losses on vitamin and mineral intake is an important consideration in dietary and epidemiological studies in India. Ironically, there is a paucity of data available on the total percentage retention of water soluble vitamins after leaching of potassium rich vegetables in India, except for a few limited studies. The present study investigates the percentage of iron and selected water soluble vitamins retained in potassium rich vegetables (Potato and Yam) after leaching by different cooking methods and to determine the best cooking method that minimize the nutrient loss in cooked vegetables. These results will also provide guidance to nutritionists regarding the effectiveness in advising patients with compromised renal function on the importance of leaching vegetables.

## MATERIALS AND METHODS

The present study involves pre-test post-test experimental design for estimating the iron, thiamine, riboflavin, niacin, ascorbic acid and folic acid content of potassium rich vegetables like potato and yam before and after leaching by various cooking methods like soaking and cooking, normal cooking, double cooking, pressure cooking and microwave cooking. The samples were selected by means of purposive sampling technique. The samples of raw vegetables namely potato and yam were weighed and 100g of each vegetables were taken for each cooking method. The vegetables were peeled and cut in to evenly cube sized pieces for processing.

### Processing methods

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 100g of all the leached vegetable samples were given for iron, thiamine, riboflavin, niacin, ascorbic acid and folic acid analysis. All the water soluble

vitamins were estimated by high–performance liquid chromatography (HPLC) and iron by 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**

The results from the micronutrient analysis showed that the percentage of the iron retained in potato which was 98% after leaching by soaking and cooking was more significant when compared to other cooking methods (p<0.01%). Higher percentage of loss was reported in pressure cooking (67%).

**Table – 1: Comparison of iron, thiamine, riboflavin, niacin and ascorbic acid content of potato before and after leaching by different cooking methods**

| S. No | Cooking methods | Micronutrients in Potato | Before leaching mg/100g | After leaching mg/100g | 't' value |
|---|---|---|---|---|---|
| | | | Mean ± SD | Mean ± SD | |
| 1. | Soaking and cooking | Iron | 0.394 ± 0.004 | 0.387 ± 0.001 | 4.350** |
| | | Thiamine | 0.098 ± 0.001 | 0.089 ± 0.001 | 16.00** |
| | | Riboflavin | 0.004 ± 0.001 | 0.003 ± 0.0001 | 0.699 NS |
| | | Niacin | 1.330 ± 0.173 | 1.022 ± 0.019 | 3.972** |
| | | Ascorbic acid | 15.660 ± 0.158 | 15.604 ± 0.148 | 2.267NS |
| 2. | Normal cooking | Iron | 0.394 ± 0.004 | 0.340 ± 0.001 | 21.526** |
| | | Thiamine | 0.098 ± 0.001 | 0.004 ± 0.001 | 157.667** |
| | | Riboflavin | 0.004 ± 0.001 | 0.003 ± 0.000 | 1.819 NS |
| | | Niacin | 1.330 ± 0.173 | 0.099 ± 0.001 | 15.972** |
| | | Ascorbic acid | 15.66 ± 0.158 | 14.33 ±0.013 | 19.633** |
| 3. | Double Cooking | Iron | 0.394 ± 0.004 | 0.331 ± 0.016 | 10.992** |
| | | Thiamine | 0.098 ± 0.001 | 0.002 ± 0.001 | 303.579** |
| | | Riboflavin | 0.004 ± 0.001 | 0.003 ± 0.000 | 1.679NS |
| | | Niacin | 1.330 ± 0.173 | 0.083 ± 0.001 | 16.120** |
| | | Ascorbic acid | 15.66 ± 0.158 | 8.11 ± 0.015 | 113.179** |
| 4. | Pressure cooking | Iron | 0.394 ± 0.004 | 0.131 ± 0.001 | 126.340** |
| | | Thiamine | 0.098 ± 0.001 | 0.001 ± 0.000 | 191.409** |
| | | Riboflavin | 0.004 ± 0.001 | 0.001 ± 0.000 | 4.384** |
| | | Niacin | 1.330 ± 0.173 | 0.015 ± 0.001 | 17.061** |
| | | Ascorbic acid | 15.66 ± 0.158 | 4.45 ± 0.015 | 169.966** |
| 5. | Micro-wave Cooking | Iron | 0.394 ± 0.004 | 0.234 ± 0.001 | 96.78** |
| | | Thiamine | 0.098 ± 0.001 | 0.001 ± 0.000 | 216.89** |
| | | Riboflavin | 0.004 ± 0.001 | 0.001 ± 0.000 | 4.243** |
| | | Niacin | 1.330 ± 0.173 | 0.001 ± 0.000 | 17.086** |
| | | Ascorbic acid | 15.66 ± 0.158 | 9.34 ± 0.01 | 94.741** |

**- Significant at 1 % level NS– Not Significant

The percentage of thiamine retained in potato after leaching by soaking and cooking (91%) was more significant when compared to normal cooking (4%), double cooking (2%), microwave cooking (1%) and pressure cooking (1%), (p<0.01%). The riboflavin content in potato which was 0.0039 mg/100g after leaching by soaking and cooking was more significant when compared to other cooking methods. The loss of riboflavin was statistically not significant after leaching by soaking and cooking, normal cooking and double cooking, while significant (p<0.01%) after pressure cooking and microwave cooking (Table 1).

The percentage of niacin retained in potato after leaching by soaking and cooking (77%) was more significant when compared to normal cooking (7%), double cooking (6%), pressure cooking (1%) and microwave cooking (0%), (p<0.01%). Similarly the percentage of ascorbic acid retained in potato after leaching by soaking and cooking (99%) was more significant when compared to normal cooking (91.5%), microwave cooking (60%), double cooking (52%) and pressure cooking (28%), (p<0.01%).

The results of the study correlates with the findings of Marin Prodanov et al., 2004, during their study on the influence of soaking and cooking on the thiamin, riboflavin and niacin contents of legumes.

**Table – 2: Comparison of iron, thiamine, riboflavin, niacin and ascorbic acid content of yam before and after leaching by different cooking methods**

| S. No | Cooking methods | Micronutrients in Yam | Before leaching mg/100g | After leaching mg/100g | 't' value |
|---|---|---|---|---|---|
| | | | Mean ± SD | Mean ± SD | |
| 1. | Soaking and cooking | Iron | 0.991 ± 0.001 | 0.990 ± 0.001 | 1.20NS |
| | | Thiamine | 0.051 ± 0.001 | 0.048 ± 0.00 | 3.474* |
| | | Riboflavin | 0.069 ± 0.001 | 0.059 ± 0.00 | 12.869** |
| | | Niacin | 0.697 ± 0.001 | 0.685 ± 0.00 | 16.971** |
| | | Ascorbic acid | 16.85 ± 0.157 | 16.110 ± 0.00 | 10.607** |
| 2. | Normal cooking | Iron | 0.991 ± 0.001 | 0.935 ± 0.015 | 8.47** |
| | | Thiamine | 0.051 ± 0.001 | 0.047 ± 0.00 | 5.65** |
| | | Riboflavin | 0.069 ± 0.001 | 0.057 ± 0.00 | 16.97** |
| | | Niacin | 0.697 ± 0.001 | 0.683 ± 0.00 | 19.79** |
| | | Ascorbic acid | 16.85 ± 0.157 | 15.30 ± 0.00 | 22.12** |
| 3. | Double Cooking | Iron | 0.991 ± 0.001 | 0.863 ± 0.001 | 321.00** |
| | | Thiamine | 0.051 ± 0.001 | 0.045 ± 0.00 | 8.485** |
| | | Riboflavin | 0.069 ± 0.001 | 0.053 ± 0.00 | 22.627** |
| | | Niacin | 0.697 ± 0.001 | 0.655 ± 0.00 | 59.397** |
| | | Ascorbic acid | 16.85 ± 0.157 | 14.33 ± 0.00 | 35.918** |
| 4. | Pressure cooking | Iron | 0.991 ± 0.001 | 0.803 ± 0.001 | 769.14** |
| | | Thiamine | 0.051 ± 0.001 | 0.041 ± 0.001 | 8.771** |
| | | Riboflavin | 0.069 ± 0.001 | 0.033 ± 0.001 | 113.842** |
| | | Niacin | 0.697 ± 0.001 | 0.605 ± 0.00 | 130.108** |
| | | Ascorbic acid | 16.85 ± 0.15 | 13.11 ± 0.00 | 53.265** |
| 5. | Micro-wave Cooking | Iron | 0.991 ± 0.001 | 0.982 ± 0.00 | 12.52** |
| | | Thiamine | 0.051 ± 0.001 | 0.047 ± 0.001 | 3.508* |
| | | Riboflavin | 0.069 ± 0.001 | 0.056 ± 0.00 | 18.385** |
| | | Niacin | 0.697 ± 0.001 | 0.698 ± 0.00 | 1.414NS |
| | | Ascorbic acid | 16.85 ± 0.157 | 16.60 ± 0.00 | 3.64* |

**- Significant at 1 % level,

* - Significant at 5 % level, NS– Not Significant

It was evident from table 2 that in yam samples before and after leaching by soaking and cooking, normal cooking, double cooking, pressure cooking and microwave cooking there was 0.2%, 6%, 13%, 19% and 1% loss of iron respectively. The loss of iron after normal cooking, double cooking, pressure cooking and microwave cooking proved 1% significance (p<0.01%).

The percentage retention of the thiamine (94% (p<0.05%)) and riboflavin (85.5%) in yam after leaching by soaking and cooking was more significant compared to other cooking methods. Similarly there was an excessive loss of thiamine (20%), riboflavin (52%), niacin (13%) and ascorbic acid (22%) after leaching of yam by pressure cooking (p<0.01%). Maximum retention of niacin (100%) and ascorbic acid (98% (p<0.05%)) in yam was observed during microwave cooking (table 2). The results associate with the finding of Orzaez Villanueva (2000).

The folic acid content of potato and yam after leaching by pressure cooking reduced significantly from 6.33 mcg/100g to 0.553 mcg/100g and from 0.893 mcg/100g to 0.70 mcg/100g respectively compared to other cooking methods (p<0.01%). The least percentage loss of folic acid in potato (7%) and yam (3%) was reported after leaching by soaking and cooking (p<0.01%). The results confirm with the observations of Shahnaz et al., 2003, in their study on the effect of peeling and cooking on nutrients in vegetables.

**CONCLUSION**

Processing and cooking conditions cause variable losses of vitamins. Losses vary widely according to cooking method and type of food. It can be concluded that among various cooking methods soaking and cooking was the most effective method in retaining iron (98%), thiamine (91%), riboflavin (75%), niacin (77%), ascorbic acid (99%) and folic acid (93%) in potato, similarly in retaining iron (99.8%), thiamine (94%), riboflavin (85.5%) and folic acid (97%) in yam. Maximum retention of niacin (100%) and ascorbic acid (98%) in yam was observed during microwave cooking. The iron content was least affected when leached by different cooking methods compared to other micronutrients.

Leaching of vegetables is recommended to renal patients in order to reduce the food mineral load. The effect of cooking loss on vitamin and mineral intake is an important consideration in dietary and epidemiological studies in India. The results of the study will provide guidance to nutritionists regarding the effectiveness in advising patients with compromised renal function on the importance of leaching vegetables.

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