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Full Length Research Paper

Effect of Blanching Time on the Mineral Contents of Selected Green Leafy Vegetables Commonly Consumed in Southwest Nigeria

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ABSTRACT

This study was carried out to determine the effect of blanching time on selected mineral contents of four frequently consumed GLVs in South western, Nigeria. Fluted pumpkin (*Telfairia occidentalis*), feather cockscomb (*Celosia argentea*) and spinach (*Amaranthus cruentus*) which are usually excluded and Water leaf (*Talinum triangulare*) which is allowed in the diets of patients with Chronic Renal Failure (CRF) were subjected to 10, 30 and 60 minutes blanching times. Four samples were generated from each vegetable species: sample A (unblanched raw vegetable), sample B (blanched vegetable for 10 minutes), sample C (blanched vegetable for 30 minutes) and sample D (blanched vegetable for 60 minutes). Calcium, magnesium, potassium, phosphorus and sodium content of the vegetables were determined according to AOAC method and Phosphorus by the Vanodo-molybdate method. Data were analysed using ANOVA and Duncan Multiple Range test at $p<0.05$. The result showed that increase in blanching time significantly increased the calcium while the potassium and sodium content of all the vegetables significantly reduced with 10 minutes blanching ($p<0.05$). Blanching for 30 minutes or more had significant reducing effect on the magnesium and phosphorus concentrations of the GLVs. Thirty minutes blanching time had significant reducing effects on the mineral contents of the vegetables except for calcium content which increased with increase in blanching time. The GLVs could be recommended for patients suffering from CRF provided they are blanched for 30 minutes.

Keywords; Blanching time, Mineral content, Green leafy vegetables

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INTRODUCTION

Vegetables are edible plants or parts of plants which usually exclude seeds and most sweet fruits. They are important sources of micronutrients which are protective nutrients in foods and few are good sources of oil and carbohydrate (Nnamani *et al.*, 2009; Adenipekun and Oyetunji, 2010). Green Leafy Vegetables (GLVs) are rich sources of varieties of vitamins including vitamins A and C; dietary fiber, and minerals such as sodium, potassium, magnesium, phosphorous, iron, calcium and phytochemicals (Centre for Young Women Health, 2005). However, GLVs are generally low in calorie and fat (Yakubu and Hamzat, 2012).

Research had indicated that a diet rich in dark GLVs lowers the risk of a variety of cardiovascular diseases; it helps in weight management and reduces the risk of cancer (AICR/WCRF, 2007). It has also been proven that adequate intake of GLVs help in the management of type-2 diabetes, maintenance of bone health and protects the eye against cataract (AICR/WCRF, 2007). Potassium content of leafy vegetable is beneficial in the control of hypertension complications (George, 2003). Oils derived from vegetables are known to be unsaturated thus helping in lowering blood lipids and reducing the occurrences of diseases associated with the damage of the coronary artery (Adenipekun and Oyetunji, 2010).

In the Western World, GLVs are usually consumed in their raw forms. However, in Nigeria, GLVs are usually subjected to various post-harvest treatments such as blanching, soaking and abrasion with or without salt (Oboh, 2005). This is done mostly to improve their palatability, to remove the bitter taste and some of anti-nutrients present in the vegetables. The various processing techniques have been reported to alter both the nutrient, antinutrient and antioxidant

properties of some commonly consumed plant foods in Nigeria (Oboh and Akindahunsi, 2004; Oboh, 2005b).

Inspite of the health benefits of GLVs, individuals with renal disease especially chronic renal failure (CRF) are restricted from consuming certain GLVs because of their potassium and phosphorus contents which need to be modified (Mitch and Klahrs, 2002). There is little information regarding the effect of blanching time, on these mineral contents, in some commonly consumed GLVs which are usually restricted from the diets of patients with chronic renal failure (CRF) in Nigeria. Therefore, this study was conducted to determine the effect of blanching time on selected mineral contents of some commonly consumed GLVs in South-Western part of Nigeria that are generally restricted from the diets of individuals with CRF.

MATERIALS AND METHODS

Sample collection: Four commonly consumed fresh GLVs namely: Water leaf (*Talinum triangulare*), pumpkin leaves (*Telfairia occidentalis*), feather cockscomb (*Celosia argentea*) and spinach (*Amaranthus cruentus)* were bought from three major markets in Ibadan: Bodija, Sango and Ojoo markets. Samples were identified in the herbarium of the Department of Botany, University of Ibadan.

Sample preparation: Each type of fresh GLVs were thoroughly washed under running water to remove sand particles and rinsed using de-ionized water. Hard stems and wilted leaves were removed and samples were drained in a stainless sieve. The leaves and tender stems were comminuted and well mixed with a spatula for homogeneity. Each of the four species of the vegetables (Water leaf (*Talinum triangulare*), Pumpkin leaves (*Telfairi occidentallis*), feather cockscomb (*Celosia argentea*) and spinach (*Amaranthus cruentus*)) was divided into four equal portions with each portion weighing 50g. For each specie of the vegetables, one portion (Sample A) was analyzed raw (not blanched) while the remaining three portions (Samples B, C, D) were subjected to three blanching times of 10 minutes, 30 minutes and 60 minutes respectively.

Blanching procedure: Approximately 50g of the edible portion (leaves and tender stems) of each species of the vegetables were separately soaked in 500 ml of boiled water (100˚C) without addition of salt for 10, 30 and 60 minutes respectively. During the process of blanching, the vegetables were gently stirred to ensure uniform blanching. Water from each sample of the vegetables was later drained off using a stainless sieve and was allowed to cool. All the samples were then oven dried at 80˚C for12 hours.

Determination of selected minerals in the samples : Determination of calcium, magnesium, potassium and sodium content were carried out on the raw and blanched samples of the vegetable species according to the method of AOAC (AOAC, 1995) using Atomic Absorption Spectrophotometric method. Phosphorus was determined by the Vanodo-molybdate method (AOAC, 1995). All analysis were carried out using triplicate samples to ensure analytical precision and quality control.

Statistical analysis

Data were analyzed using descriptive statistics such as mean with their standard deviations; Analysis of Variance (ANOVA) and Duncan Multiple Range test were used to compare mean variance. Level of significance was set at 5% level of probability ($p<0.05$).

RESULTS

Mineral content of raw green-leafy vegetables

The mineral contents of the four raw green-leafy vegetables in mg/100g are reported in table 1. Raw spinach had the highest calcium (2.43±0.12 mg), sodium (0.12±0.01 mg) and phosphorus contents (0.38±0.01 mg), feather cockscomb had the highest magnesium content (1.86±0.01 mg) while waterleaf had highest potassium content (8.29±0.11 mg).

Table 1:
Mineral content of raw green-leafy vegetables in mg/100g

Vegetables	Ca	Mg	K	Na	P
Waterleaf	0.84 ±0.12	1.09 ±0.03	8.29 ±0.11	0.04 ±0.01	0.19 ±0.01
Pumpkin leaf	0.46 ±0.01	0.39 ±0.01	1.24 ±0.02	0.10 ±0.00	0.26 ±0.01
Feather cockscombs	1.80 ±0.10	1.86 ±0.01	4.80 ±0.12	0.04 ±0.00	0.28 ±0.01
Spinach	2.43 ±0.12	1.58 ±0.01	5.40 ±0.12	0.12 ±0.01	0.38 ±0.01

Values represent means of triplicate. Values in the same columns with different superscripts are significantly different ($P\leq 0.05$)

Table 2:
Mineral content of Water leaf (*Talinum triangulare*) before and after blanching (mg/100g)

Sample	Ca	Mg	K	Na	P
Raw	0.84^{d} ±0.12	1.09^{a} ±0.03	8.29^{a} ±0.11	0.04^{a} ±0.0	0.19^{a} ±0.01
Blanched (10mins)	0.93^{c} ±0.02	0.64^{b} ±0.01	3.41^{b} ±0.01	0.03^{b} ±0.12	0.17^{a} ±0.02
Blanched (30mins)	1.10^{b} ±0.01	0.20^{d} ±0.01	0.51^{c} ±0.03	0.02^{b} ±0.01	0.16^{a} ±0.00
Blanched (60 mins)	1.39^{a} ±0.01	0.10^{c} ±0.00	0.35^{d} ±0.01	0.01^{b} ±0.002	0.12^{b}± 0.03

Values represent means of triplicate. Values in the same columns with different superscripts are significantly different ($P\leq 0.05$)

Mineral content of Water leaf (*Talinum triangulare*)
The mineral contents of water leaf before and after blanching are presented in Table 2. Calcium content was significantly increased with blanching time (P<0.05). Potassium and sodium contents of the vegetable significantly decreased with 10 minutes blanching time while the magnesium reduced significantly after 30 minutes (P< 0.05). The phosphorus content of water leaf was generally low but reduced significantly with 30 minutes blanching time.

Mineral content of Pumpkin leaves (*Telfairia occidentalis*)
Table 3 shows the mineral content of pumpkin leaves before and after various blanching time. Calcium content increased significantly with blanching time. There was no significant reduction in the magnesium content of the vegetable until it was blanched for 30 minutes. Similarly, there was no significant change in the phosphorus content of the vegetable until 30 minutes blanching time. A significant reduction was observed in the magnesium, potassium, sodium and phosphorous content of the vegetable when blanched for 30 minutes or more.

Table 3:
Mineral content of Pumpkin leaves (*Telfairia occidentalis*) before and after blanching (mg/100g)

Sample	Ca	Mg	K	Na	P
Raw	0.46^{d} ±0.01	0.39^{a} ±0.01	1.24^{b} ±0.02	0.10^{a} ±0.00	0.26^{a} ±0.01
Blanched (10mins)	0.58^{c} ±0.02	0.39^{a} ±0.02	0.16^{a} ±0.01	0.02^{b} ±0.01	0.24^{a} ±0.01
Blanched (30mins)	0.82^{b} ±0.00	0.21^{c} ±0.04	0.06^{b} ±0.01	0.02^{a} ±0.00	0.16^{a} ±0.01
Blanched (60 mins)	1.13^{a} ±0.12	0.19^{b} ±0.02	0.01^{c} ±0.02	0.02^{b} ±0.01	0.10^{a} ±0.01

Values represent means of triplicate. Values in the same columns with different superscripts are significantly different (P≤ 0.05)

Table 4:
Mineral content of Feather cockscomb (*Celosia argentea*) before and after blanching (mg/100g)

Sample	Ca	Mg	K	Na	P
Raw	1.80^{d} ±0.10	1.86^{a} ±0.01	4.80^{a} ±0.12	0.04^{a} ±0.00	0.28^{a} ±0.01
Blanched (10mins)	2.26^{c} ±0.12	1.68^{b} ±0.01	1.44^{b} ±0.02	0.03^{b} ±0.00	0.24^{a} ±0.02
Blanched (30mins)	2.90^{b} ±0.11	0.93^{d} ±0.02	0.86^{b} ±0.01	0.02^{b} ±0.01	0.19^{b} ±0.01
Blanched (60 mins)	4.84^{a} ±0.11	0.40^{c} ±0.01	0.42^{c} ±0.13	0.02^{b} ±0.00	0.18^{b} ±0.00

Values represent means of triplicate. Values in the same columns with different superscripts are significantly different (P≤ 0.05)

Mineral content of Feather cockscomb (*Celosia argentea*)
Table 4 shows that in similarity to other vegetables, the calcium content of feather cockscomb significantly increased with blanching time (P< 0.05). The sodium and the potassium contents significantly decreased with 10 minutes blanching time (P< 0.05). Magnesium and phosphorus content was not significantly affected with blanching until after 30 minutes (P>0.05).

Mineral content of Spinach (*Amaranthus cruentus*)
The mineral content of spinach before and after blanching is presented in Table 5. Calcium content of the vegetable significantly increased with blanching time (P< 0.05). Potassium and sodium contents of the vegetable decreased significantly with 10 minutes blanching time (P< 0.05). However, there was no reduction in the magnesium and phosphorus contents until the vegetable was blanched for 30 minutes (p< 0.05).

Table 5:
Mineral content of Spinach (*Amaranthus cruentus*) before and after blanching (mg/100g)

Sample	Ca	Mg	K	Na	P
Raw	2.43^{c} ±0.12	1.58^{a} ±0.01	5.40^{a} ±0.12	0.12^{a} ±0.01	0.38^{a} ±0.01
Blanched (10mins)	3.93^{a} ±0.11	0.85^{b} ±0.12	2.03^{b} ±0.01	0.04^{b} ±0.00	0.25^{b} ±0.01
Blanched (30mins)	4.06^{a} ±0.02	0.77^{b} ±0.02	0.65^{c} ±0.01	0.03^{b} ±0.00	0.15^{b} ±0.00
Blanched (60 mins)	4.53^{b} ±0.02	0.60^{c} ±0.01	0.47^{d} ±0.01	0.02^{b} ±0.00	0.10^{c} ±0.01

Values represent means of triplicate. Values in the same columns with different superscripts are significantly different (P≤ 0.05)

DISCUSSION

Traditional GLVs have been identified as available cheap sources of micronutrients in the diet of any population (Chweya and Eyzaguirre, 1999). However, in spite of the huge benefits derived from consumption of GLVs, they are being restricted from the diet of individuals suffering from CRF mainly because of the potassium and phosphorous contents of the vegetables; thereby depriving patients with CRF of other benefits such as dietary fibre and consumption of varieties of GLVs.

This study has revealed that, out of the four vegetables analyzed, raw spinach had the highest calcium content (2.43mg/100g), followed by feather cockscomb (1.80mg/100g) while pumpkin leaves had the lowest calcium concentration (0.46mg/100g). The calcium contents of the vegetables were found to increase with blanching time. Oxalate is found in nature in most plants and occurs both as soluble and insoluble salts with calcium (Park, Jane and Lee, 1994). About 30% of the total calcium in vegetables is known to be bound with soluble oxalate while the remaining 70% exists as insoluble oxalate. However, blanching has been reported to decrease the soluble oxalate content of vegetables by leaching into water thereby releasing more calcium within the vegetable (Krim,

Joon and Jang, 1993; Noonan and Savage, 1999; Concon, 1988). Soluble oxalates were reduced by 66% in vegetables by leaching into water thus releasing the bound nutrients (Brogreen and Savage, 2003). This could partly explain the reason for increase in calcium concentrations observed in the blanched GLVs analyzed in this study. The increase in calcium content of GLVs makes it beneficial to patients with CRF since more calcium will be made available for absorption into the system. Availability of more calcium for absorption could help patients with CRF to prevent renal osteodystrophy; a condition whereby abnormal amounts of calcium are released from the bone as a result of low serum calcium (Mitch and Klahrs, 2002).

It is essential to control sodium and potassium content of the diets of individuals suffering from CRF in order to reduce the risk of developing edema and hyperkalemia due to elevated serum sodium and potassium levels. Hyperkalemia could cause uneven heart beat which can result into death. Concentration of potassium was highest in raw water leaves (8.29mg/100g) followed by spinach (5.40mg/100g) and the lowest in pumpkin leaves (1.24mg/100g). This information makes pumpkin leaf a better choice over waterleaf and spinach for patients with CRF. Sodium and phosphorus were generally low in all raw GLVs. Spinach and pumpkin leaves were found to contain the highest concentration of sodium while water leaves and feather cockscomb also had the lowest concentration of sodium. The highest magnesium concentration was observed in raw feather cockscomb and the lowest in raw pumpkin leaves. This study has shown that blanching for 10 minutes reduced potassium and sodium contents of GLVs significantly. This indicates the solubility and the leaching of these minerals into the water because they are highly reactive metal which readily reacts with water (Michael, 2006). Spinach was observed to have the highest content of phosphorus while water leaves contained the lowest content among the vegetables analyzed. This observation suggests that the mineral content of vegetables differs. Differences in species, location, agricultural practices, rainfall, use of irrigation and possibly temperature may contribute to the difference in the mineral contents of the vegetables (Ejoh et al, 2007). The observation made in this study regarding the effects of blanching on various vegetables analysed agrees with the reports of other researchers who also observed significant reduction in the potassium, sodium, magnesium and phosphorous contents and increase in calcium content of blanched vegetables (Mepha et al, 2007; Oladumoye et al, 2005; Ilelaboye et al, 2013). Blanching for 10 minutes significantly reduced potassium and sodium contents of the vegetables however, no significant reduction in the magnesium and phosphorus content of all the vegetables occurred until after 30 minutes of blanching.

In conclusion, this study has shown that the mineral content of the selected GLVs varied widely. The highest mineral in the raw GLVs were potassium, magnesium and calcium while sodium and phosphorous were generally low in the raw vegetables. Different blanching time had various reducing effects on the different mineral contents of the vegetables. This study indicates that blanching for 30 minutes significantly reduced the mineral contents of vegetables. Blanching for 30 minutes will be necessary to reduce the phosphorous and magnesium content while blanching for 10 minutes is required to significantly reduce the sodium or potassium content of GLVs. Green-leafy vegetables could be recommended for patients suffering from CRF provided they are blanched for 30 minutes. Also increase in blanching time increases the calcium content of GLVs which makes calcium more available to patients with CRF from blanched GLVs.

REFERENCES

Nnamani CV, Oselebe HO and Agbatutu A (2009): Assessment of Nutritional Values of Three Underutilized Indigenous Leafy Vegetables of Ebonyi State, Nigeria. Afr. *J. Biotechnol.* 2009; 8(9): 2321- 2321.

Adenipekun CO and Oyetunji OJ (2010): Nutritional Values of some tropical vegetables. *J. Appl. Biosci*. 35: 2294-2300.

The Center for Young Women's Health. **Dark green leafy vegetables (2005)**: Retrieved May 8, 2014 Available at http://www.youngwomenshealth.org/leafy.htl.

Yakubu N and Hamzat_ R (2012): Effect of Processing Methods on the Nutritional Contents of Bitter Leaf (Vernonia Amygdalina) *J. Food and Nutr. Res.* 2012; 2(1):26-30

AICR/WCRF (2007): Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. A project of World Cancer Research Fund International Washington DC. Available at http://www.aicr.org/assets/docs/pdf/reports/ Second_Expert_Report.pdf

George PM (2003): Encyclopedia of Foods. Humane Press; Washington 2003; (1): 526

Oboh G (2005): Effect of some post-harvest treatments on the nutritional properties of Cnidoscolus acontifolus leaf. *Pak J Nutr*. **4 (4):** 226-230.

Oboh G and Akindahunsi AA (2004): Change in the Ascorbic acid, Total phenol and Antioxidant activity of some Sun-Dried Green Leafy Vegetables in Nigeria. *Nutr. and Health*,; 18: 29-36.

Oboh G (2005b): Effect of blanching on the antioxidant property of some tropical green leafy vegetables. *Food Sci. Tec. /LWT* ; 38: 513 – 517.

Mitch W and Klahrs E (2002): Calcium, Phosphorus and Vitamin D In: Hand book of Nutrition and the Kidney: Forth Ed; Lippincott Wilkins, Philadelphia, USA.; 93-117.

AOAC (2005): Official Method of Analysis 18th ed. Washington D.C p 106

AOAC (1995); Official Method of Analysis 17th Edn. Washington DC.

Chweya JA and Eyzaguirre PB (1999): The Biodiversity of Traditional Leafy Vegetables, International Plant Genetic Resources Instit. (IPGRI), Rome (Italy). ISBN-13: 978-92-9043-404-7; 182

Park SS, Jang MS and Lee KH (1994): Effect of blanching condition on the chemical composition of the spinach grown in winter green-house *J Korean Soc Food Nutr*; 23: 62-67

Krim NY, Joon SJ and Jang MS (1993): Effect of blanching on the chemical properties of different kinds of spinach. *J Korean Soc Food Sci.*; **9**:204-209

Noonan SC and Savage GP (1999): Oxalate content of foods and its effect on humans. *Asia Pac. J. Clin. Nutr.*; **8(1)**:64-74.

Concon JM (1998): Food toxicology -Principles and Concepts, Marcel Dekker, New York; 416-419.

Brogren M and Savage GP (2003): Bioavailability of soluble oxalate from spinach eaten with and without milk products. *Asia Pac. J Clin Nutr*; 12 (2): 219-224

Micheal EJL (2006): Major mineral elements In H Smith and C Patterson (Eds) Food science Nutrition and Health. 7th ed. Edward Arnold UK Arnold.; 192-193

Ejoh RA, Djuikwo VN, Gouado I and Mbofung CM (2007): Effect of method of processing and preservation on some quality parameters of three non- conventional leafy vegetables. *Pak. J. Nutr.*; 6(2): 128- 133

Mepba HD, Eboh L and Banigo DEB (2007): Effects of Processing Treatments on The Nutritive Composition and Consumer Acceptance Of Some Nigerian Edible Leafy Vegetables. *AJFAND*; **7:(1**)

Oladumoye OO, Ojeniyi S and Bankole AO (2005): Mineral Composition of tender and matured cassava leaves after home cooking procedures. Proceedings: 29th Annual Conference of the Nigerian Inst. of Food Science and technology held in Eboyi State University, Abakaliki, Nigeria; 151-152.

Ilelaboye NOA, Amoo IA and Pikuda OO (2013): Effect of cooking methods on mineral and anti-nutrient composition of some green leafy vegetables. *Arch. of Appl. Sci. Res.*; 5 (3):254-260