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Effect of Processing Treatments on the Micronutrients and Phytochemicals in *Lasianthera africana* Leaf

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ABSTRACT

White variety of *Lasianthera africana* leaves were cut (2mm width), shared into four equal portions of 1kg each and subjected to three different treatments while one portion (raw leaf) served as the control. The treatments were oven drying (50°C), blanching in hot water at 100°C for 3 minutes and dried (50°C) and blanching in unripe plantain peel ash solution (0.50%) at 100°C for 3 minutes and dried (50°C). The effects of these treatments on the minerals, vitamins and phytochemicals were investigated. The raw leaves contained calcium (190.25±0.44mg/100g), sodium (75.69±0.95mg/100g), potassium (78.98±0.78/100g), magnesium (14.68±0.74/100g), zinc (5.95±0.52mg/100g), iron (3.96±0.55mg/100g), phosphorus (17.79±0.81mg/100g), ascorbic acid (109.64±0.0.08mg/100g), beta-carotene (2.86±0.04mg/100g), riboflavin(0.22±0.03mg/100g), thiamine(1.01±0.06mg/100g) alkaloid (2.67±0.33g/100g), flavonoids (0.32±0.03g/100g), saponin (3.09±0.04g/100g), tannins (0.28±0.03g/100g), HCN (2.16±0.08mg/100g), phytate (33.46±0.08mg/100g), oxalate (9.54±0.06mg/100g) and trypsin inhibitor (1.73±0.04 TUI/mg). The unblanched and blanched dried samples had lower values of the above constituents than the raw leaf. Unblanched dried leaves retained higher minerals, vitamins and phytochemicals than the blanched dried samples. Unripe plantain peel ash solution blanched and dried leaves retained higher minerals but lower vitamins and phytochemicals than hot water blanched and dried samples.

Key Words: *Lasianthera africana* Leaf, Processing, Nutrients, Phytochemicals.

INTRODUCTION

Vegetables play a crucial role in alleviating hunger and food security by contributing bulk of the nutritional components in the diet of people where animal products are in short supply [1, 2]. Green leafy vegetables as components of traditional foods are essential for rural subsistence livelihood and health. They provide the most affordable sources of micronutrients and health promoting phytochemicals for low income people in developing countries especially those living in rural communities [3]. Leafy vegetables are important sources of iron, potassium, calcium, magnesium, zinc, provitamin A, thiamine, ascorbic acid, riboflavin and folic acid [4, 5]. The dietary fibre in leafy vegetables increases bulk and reduces the incidence of constipation and other related diseases [6]. Some of the phytochemicals in green leafy vegetables have potentials in helping to reduce the risk of several deadly diseases in man [7, 8]. High consumption of green leafy vegetables can therefore play vital role in human nutrition and health [9]. Despite these nutritional benefits, the vegetable is known to contain anti-nutrients that might undermine these nutritional benefits. The presence of anti-nutritional factors in vegetables affects the utilization of some essential nutrients such as calcium and zinc [10, 11]. *Lasianthera africana* is one of the top six green leafy vegetables commonly consumed by Efik and Ibibio ethnic groups of Nigeria [12]. It belongs to the family lcacinaceae. The plant is called "editan" in Efik and Ibibio local dialects of Nigeria. It is a perennial grabrous, shrub that reaches a height of 61 – 136cm [13]. Four local varieties of the plant distinguish by their taste, leaf colour and ecological distribution are available [14]. The varieties are "afia" (white variety), "obubit" (black variety), "idim" (riverine variety), and "akai" (forest variety). Traditionally, the leaves of all ethno-varieties are utilized for both food and therapeutic purpose especially in rural communities where they are mostly found. The leaves are rich in chemical compounds of nutritional and therapeutic importance and are used in traditional concoctions for the treatment of ailments like constipation and general stomach ache [15, 16]. One unique characteristic of *L. africana* leaf is that it has bitter taste that requires debittering prior to culinary use. Debittering helps to enhance palatability and acceptability of the soup prepared with the leaf. Traditionally, the leaf is usually debittered by soaking in hot water, squeeze washing with water or treatment with aqueous extract from unripe plantain peel ash. It has been documented that various processing methods cause losses in some of the nutrients and bioactive compounds in foods [1, 3, 10, 11]. This study was designed to evaluate the effects of debittering treatments on the nutrients and bioactive compound in the leaf.

MATERIALS AND METHODS

Twigs of *Lasianthera africana* (white variety) were harvested from a garden at Aka Offot in Uyo Local Government Area of Akwa Ibom State, Nigeria and authenticated at the Taxonomy Unit of the

Department of Botany and Ecological Science, University of Uyo, Nigeria. The leaves were destalked, washed in potable water, spread under shade to air dry and cut (2mm width). The cut leaf was divided into four equal portions of 1kg each. The first portion (raw leaf) was not given any processing treatment and served as the control sample (T_1). The second portion (T_2) was dried at 50°C for 36 hours in a conventional air oven (Model P.P. 22 US, Genlab, England), milled, packaged in a plastic container, labeled and stored at 4°C. The third portion (T_3) was blanched in water (1:3w/v) at 100°C for 3 minutes, drained, cooled, oven dried at 50°C for 36 hours, milled, packaged in plastic container, labeled and stored at 4°C. The fourth portion (T_4) was blanched in 0.50% solution of unripe plantation peel ash (1:3w/v) for 3 minutes at 100°C, drained, cooled, oven dried at 50°C for 36 hours, milled, packaged in plastic container, labeled and stored at 4°C. All the samples were analyzed for the proximate composition, minerals, vitamins and phytochemicals. The minerals (K, Na, Ca, Mg, Zn, Fe and P) were determined using atomic absorption spectrophotometer (UNICAM, Model 939, UK) as described by AOAC (17). Ascorbic acid, beta-carotene, thiamine and riboflavin were determined using the methods described by AOAC (17). Alkaloid and flavonoid were determined using the methods of Harborne [18]. Saponin, Hydrogen cyanide (HCN), oxalic acid and tannins were determined by the methods described in AOAC [17]. Phytate was determined by the method described by Oberleas (19) and Trypsin inhibitor by the method described by Arnfield *et al.* [20].

Statistical Analysis

Data obtained were subjected to one way Analysis of Variance (ANOVA) using SPSS version 18 statistical package (SPSS, Inc. USA) to determine variation between treatments. Means of data generated were separated using Duncan Multiple Range Test (DMRT). Results were expressed as mean ± SD (standard deviation) of triplicate determinations. Significant variation was accepted at $p<0.05$.

RESULTS AND DISCUSSIONS

Effect of Treatments on Mineral Content in *L. africana* leaf

The result revealed that all the minerals exhibited losses to varying degrees and with different treatments (Table 1). Unblanched oven dried sample (T_2) had significantly ($p<0.05$) lower K, Na, and Ca than the raw lead, but the reduction in Mg, Zn, Fe and P were not significant ($p>0.05$). These observations compared with the result of Kiremire *et al.* [21] who reported that oven drying, solar drying and traditional sun drying of amaranthus resulted in reductions in Ca, K, Na, Mg, Fe and P. According to the authors, the levels of reduction varied with the drying methods. The lower level of minerals in the blanched and dried leaves relative to the unblanched dried samples could be due to leaching of the minerals during blanching. Musa and Ogbadoyi [11] similarly reported lower retention of minerals in *Hibiscus sabdariffa* that was blanched in hot water compared with the sun dried sample. Samples blanched in 0.50% solution of unripe plantain peel ash and dried retained more minerals than hot water blanched and dried sample, but the effect was not significant ($p>0.05$) except for potassium. This observation could be attributed to possible contribution of these minerals from the unripe plantain peel ash used in the blanching solution. Similar observation was reported by Ejoh *et al.* [3] for species of *Vernonia* blanched in hot water and solutions of "kanwa". The result shows that the solution of unripe plantain peel ash not only debittered the leaf, but also helped in better retention of minerals in the blanched leaf relative to hot water blanched samples.

Effect of Treatments on some Vitamins

The results revealed that the processing treatments caused losses of vitamins when compared with the raw leaf but the losses varied from one vitamin to another and with the treatment (Table 2). Ascorbic acid was very susceptible to processing treatments. The high solubility of ascorbic acid in water and the relative ease with which it is oxidized make this vitamin particularly susceptible to processing conditions [22, 23]. The loss of ascorbic acid in the unblanched dried sample could be attributed to oxidation and heat labile nature of the vitamin. The significantly ($p<0.05$) lower levels of ascorbic acid in the blanched and dried samples (T_3 and T_4) relative to unblanched dried sample (T_2) could be due to leaching of soluble substances including ascorbic acid during blanching. In conformity with these observations, other authors [1, 2, 11] had earlier reported that hot water blanched leafy vegetables had significantly lower ascorbic acid than the unblanched dried leaves. The significantly ($p<0.05$) lower level of ascorbic acid in ash solution blanched and dried sample (T_4) relative to hot water blanched and dried sample (T_3) could be due to the fact that the alkaline condition predisposed the vitamin to decomposition which enhanced the level of losses. Ihekoronye and

Ngoddy [22] had earlier noted that when leafy vegetables are cooked with baking soda to retain the greenness, they lose much of the ascorbic acid. Bata carotene is not soluble in water but in fat and most organic solvents. The significant ($p<0.05$) decrease in beta-carotene in both the unblanched and blanched dried samples could therefore be attributed to possible destruction by heat and oxidation reactions [24, 25, 26]. Similar reduction in beta-carotene content of three amaranthus species as a result of oven, solar and sun drying had been reported [22]. The unblanched dried sample (T_2) had non-significantly ($p>0.05$) higher beta-carotene content than the blanched and dried samples (T_3, T_4). The loss of carotene according to Meyer [24] is rapid in products that had been blanched and dehydrated. According to the author, when the cell is killed by blanching, drying or chemical reagents, the chromoplast disintegrate and the carotene dissolves in oil droplets. The non-significant ($p>0.05$) difference observed in the beta-carotene content of samples that were blanched either in hot water or 0.50% ash solution confirms the earlier statement made by Meyer [24] that carotenoid is not affected by changes in pH.

The unblanched dried leaf (T_2) and the blanched dried samples (T_3 and T_4) had non-significantly ($p>0.05$) lower riboflavin content than the raw leaf (T_1). The non-significant ($p>0.05$) lower content of riboflavin in blanched dried samples relative to the raw leaf and unblanched dried sample could be due to leaching during blanching. Similar reduction in riboflavin content of non-conventional leafy vegetables blanched in hot water had been reported [27]. The non-significantly ($p>0.05$) lower content of riboflavin in hot ash solution blanched and dried sample (T_4) than in hot water blanched sample and dried sample (T_3) could be due to the fact that riboflavin is more soluble in alkaline solution than in water [23]. According to Fellows [28], riboflavin is easily destroyed under alkaline conditions, light and excessive heat. Thiamine is sensitive to heat [29] and is very soluble in water [26]. The non-significantly ($p>0.05$) lower content of thiamine in the unblanched dried leaf (T_2) relative to the raw leaf (T_1) may be attributed to the effect of heat on thiamine during drying in the oven. The significantly ($p<0.05$) lower content of thiamine in the blanched and dried samples (T_3 and T_4) relative to the raw leaf and unblanched dried sample could be attributed to leaching and thermal destruction. Jacob [23] and

Grosvernor and Smolin [29] had earlier noted that thiamine in foods may be destroyed during cooking or storage because it is sensitive to heat, oxygen and low acid conditions.

Effect of Treatments on Phytochemicals

All the non-nutritive phytochemicals evaluated in this study were affected by the processing treatments as evidence by lower values in the treated samples relative to the values in the raw leaf (Table 3). Available information in the literature show that simple traditional methods of food processing such as soaking, boiling, toasting and autoclaving can cause reductions in non-nutritive phytochemicals in foods [10, 11, 30, 31]. The lower levels of alkaloids, flavonoids, saponins, tannins, hydrogen cyanide, phytate, oxalate and trypsin inhibitor in the treated samples compared with the values in the raw leaf could be due to thermal destruction and leaching of these constituents into the blanching media [30, 32]. Samples that were blanched and dried (T_3 and T_4) had lower levels of the above constituents than the unblanched dried samples (T_2). This observation agrees with the report of Musa and Ogbadoyi (11) for hot water blanched and oven dried *Hibiscus sabdariffa* leaf. According to Ogbadoyi *et al.* [33] blanching of vegetables in water ruptures the cell walls and can subsequently cause leaching of the cell contents including anti-nutrients and toxic substances. Hot ash blanched and dried sample (T_4) had lower phytochemicals than hot water blanched and dried sample (T_3). Adeboye and Babajide [32] similarly reported that vegetables blanched in 1% potash had lower oxalate, phytate, saponin and tannin contents than hot water blanched samples. The reduction in anti-nutrients such as oxalate, phytate, tannins and trypsin inhibitor could have positive impact on the health of consumers, particularly in enhancing the bioavailability of some essential dietary minerals and protein. Phytate for instance forms complexes with protein (protein-phytate complex) and chelates dietary minerals like calcium, magnesium, iron and zinc and lowers their bioavailability [29]. The result of this study suggests that unripe plantain peel ash solution would be more effective in reducing the antinutrients in *L. africana* leaf. On the other hand, some phytochemicals such as alkaloid, flavonoids, saponin and tannin present in *L. africana* leaf have health promoting properties and are associated with reduction in the risk of cancer and other degenerative diseases [34, 35]. Flavonoids for instance, are said to be strong antioxidants and free radical scavengers which prevent oxidative cell damage [31, 37]. It is therefore important to minimize their losses during processing of the leaf because of their health benefits.

CONCLUSION

Different processing treatments employed in this study to *L. africana* leaf led to varying losses of the nutrients and non-nutrient phytochemicals. Unblanched dried leaf exhibited lower losses of protein, minerals, vitamins and phytochemicals than the blanched and dried samples. Samples blanched in unripe plantain peel ash solution (0.50%) and dried retained higher protein and minerals, but lower vitamins and phytochemicals than hot water blanched and dried samples.

Table 1: Effect of Processing Treatments on the Mineral Contents of *Lasianthera africana* Leaf (mg/100g)

	Treatments			
Minerals	**T_1**	**T_2**	**T_3**	**T_4**
K	$78.98^{a}\pm0.78$	$75.55^{bc}\pm0.34$	$70.43^{d}\pm0.16$	$72.95^{c}\pm0.55$
Na	$75.69^{a}\pm0.95$	$71.83^{b}\pm0.41$	$60.10^{c}\pm0.47$	$62.35^{c}\pm0.57$
Ca	$190.25^{a}\pm0.44$	$186.36^{b}\pm0.78$	$177.91^{c}\pm0.11$	$179.00^{c}\pm0.55$
Mg	$14.68^{a}\pm0.74$	$13.09^{ab}\pm0.35$	$12.23^{b}\pm0.21$	$12.30^{b}\pm0.42$
Zn	$5.95^{a}\pm0.52$	$5.20^{a}\pm0.24$	$5.10^{a}\pm0.09$	$5.17^{a}\pm0.27$
Fe	$3.96^{a}\pm0.55$	$3. 82^{a}\pm0.59$	$3.45^{a}\pm0.41$	$3.53^{a}\pm0.41$
P	$17.79^{a}\pm0.81$	$16.50^{a}\pm0.52$	$15.34^{b}\pm0.06$	$16.22^{ab}\pm0.57$

Values are Means ± SD of triplicate determinations. Means on the same row with different superscripts are significantly different at $p<0.05$

T_1 = Raw *Lasianthera africana* Leaf

T_2 = Unblanched dried *Lasianthera africana* leaf

T_3 = Hot water blanched (3 min) and dried *Lasianthera africana* leaf

T_4 = Hot ash (0.50%) blanched (3 min) and dried *Lasianthera africana* leaf.

Table 2: Effect of Processing Treatments on the Vitamin Contents in *Lasianthera africana* Leaf (mg/100g)

Treatments	Ascorbic acid	Beta-carotene	Riboflavin	Thiamine
T_1	109.64^a±0.08	2.86^a±0.03	0.22^a±0.03	1.01^a±0.06
T_2	74.31^b±0.03	1.97^b±0.04	0.21^a±0.01	0.86^a±0.08
T_3	65.12^c±0.17	1.89^b±0.03	0. 19^a±0.03	0.61^b±0.05
T_4	59.72^d±0.15	1.86^b±0.06	0.16^a±0.00	0.54^a±0.03

Values are Means ± SD of triplicate determinations. Means on the same column with different superscripts are significantly different at $p<0.05$

T_1 = raw *Lasianthera africana* leaf
T_2 = unblanched dried *Lasianthera africana* leaf
T_3 = hot water blanched (3 min) and dried *Lasianthera africana* leaf
T_4 = hot ash (0.50%) blanched (3 min) and dried *Lasianthera africana* leaf.

Table 3: Effect of Processing Treatments on the Phytochemical Contents of *Lasianthera africana* Leaf

	Treatments			
Phyto-chemicals	T_1	T_2	T_3	T_4
Alkaloid (g/100g)	2.67^a±0.33	2.48^a±0.07	2.14^{ab}±0.18	1.84^b±0.06
Flavonoid (g/100g)	0.32^a±0.03	0.29^{ab}±0.02	0.21^{bc}±0.01	0.15^c±0.01
Saponins (g/100g)	3.09^a±0.04	3.04^a±0.13	2.75^a±0.84	2.31^a±0.03
Tannins (g/100g)	0.28^a±0.01	0.26^a±0.04	0.24^a±0.06	0.19^a±0.01
HCN (mg/100g)	2.16^a±0.08	1.73^b±0.06	0.82^c±0.07	0.62^c±0.05
Phytate (mg/100g)	33.46^a±0.06	29. 51^b±0.27	22.69^c±0.33	15.07^d±0.07
Oxalate (mg/100g)	9.54^a±0.08	7. 92^b±0.03	4.31^c±0. 14	3.73^d±0.04
Trypsin inhibitor (TUI/mg)	1.73^a±0.04	1.41^b±0.01	1.20^c±0.07	0.99^d±0.06

Values are Means ± SD of triplicate determinations. Means on the same row with different superscripts are significantly different at $p<0.05$

T_1 = raw *Lasianthera africana* leaf
T_2 = unblanched dried *Lasianthera africana* leaf
T_3 = hot water blanched (3 min) and dried *Lasianthera africana* leaf
T_4 = hot ash (0.50%) blanched (3 min) and dried *Lasianthera africana* leaf.

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