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Anti-Nutrient Composition of Pumpkin Leaf (*Telfairia occidentalis*) at Three Temperature Regimes

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Abstract: The anti-nutrient composition including oxalate, phytic acid, cyanide and tannin of pumpkin leaf (*Telfairia occidentalis*) was determined at three temperature regimes (normal (37°C), 60°C and boiling point (100°C)). The oxalate and phytic acid content of the leaf were evaluated by titrimetric method while the cyanide and tannin content of the leaf was determined by spectrophotometric method. The vegetable, *T. occidentalis* was subjected to various processing conditions including sun drying, boiling at 60°C, boiling at 100°C, oven drying at 60°C, oven drying at 100°C. The mean oxalate content ranged from 0.18 mg/100 g of boiled sample at 100°C to 1.17 mg/100 g of raw sample. The mean of phytic acid content ranged from 6.15 mg/100 g of oven dried sample at 60°C to 28.38 mg/100 g of raw samples. The mean of tannin content ranged from 4.66 mg/100 g of boiled sample at 100°C to 5.72 mg/100 g of raw sample. The mean of cyanide content range from 17.69 mg/100 g of boiled at 100°C to 38.98 mg/100 g of raw samples. It was observed that the boiled sample at 100°C processing condition was most impactful for anti-nutrient reduction. Hence this study will help dieticians and health officers to know the best processing methods for pumpkin leaf.

Key words: Anti-nutrients processing conditions, temperature, *Telfairia occidentalis*

INTRODUCTION

Telfairia occidentalis belongs to the tribe of *joliffieae*, of the sub family of *cucurbitaceae* (Aregheore, 2007). It is a leaf and seed vegetable of commercial value, grown across the low-land humid tropics of West Africa. The leading producers of fluted pumpkin in West Africa are Nigerians, Ghanaians and Sierra leonians (Nkang *et al.*, 2003). It is a tropical vine grown primarily, for the leaves and edible seeds as an important component of food to many people in West Africa (Longe *et al.*, 1983; Fagbemi *et al.*, 2005). Young shoots and leaves are the main part used in soup.

Fluted pumpkin, (*Telfairia occidentalis*) is commonly grown in the Niger Delta region of Nigeria, for its nutritional leaves and seeds. Locally, it is called Ubong by the Efiks and Ibibios, Ugu by the Igbos, Ewekoro by the Yorubas and Ekumanku by the Ejashains of Nigeria and Cameroon. The plant is perennial, drought tolerant and usually rows trellished. It needs a well drained soil, some water and sun light. Fluted pumpkin leaves are rich sources of proteins, oil, vitamins and minerals that enhance, nourish, protect and heal the body. The leaves are low in crude fibre but rich sources of folic acid, calcium, zinc, potassium, cobalt, copper, iron, vitamin A, C and K; they are of medicinal value as well (Ladeji *et al.*, 1995; Ajibade *et al.*, 2006). Young leaves of *T. occidentalis* sliced and mixed with coconut water and

salt are used to treat convulsion in ethno medicine and the roots are used as a rodenticide. The leaf extract is useful in the management of hypercholesterolemia, liver problems and impaired immune defense system. Vegetables are also known as excellent sources of natural energy boosters. *T. occidentalis* like other leafy vegetables also contains considerable levels of certain anti-nutrients and toxic substances which have been shown to have negative effect on animal and human health at high concentrations (Morton, 1987; Ekpedita *et al.*, 2000). However, the content of nutrients and toxic substances in this vegetable like others are known to be influenced by the effect of heat on the vegetable. This work is therefore aim at knowing the various amounts of anti-nutrients in these vegetable and also the best processing condition for this vegetable. We hereby hypothesize that the amount of anti-nutrient in the unprocessed (raw) sample is the same as the amount present in the various processed (sun dried, boiled at 60°C, boiled at 100°C, oven dried at 60°C, oven dried at 100°C) samples.

MATERIALS AND METHODS

Sample preparation and treatment: *Telfairia occidentalis* were bought from Ugbogio market in Ovia North East L.G.A of Edo State, Nigeria and were all identified by a herbarium Mr. Osaigbovo A.U of the

Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City. The research was conducted at the main laboratory, Faculty of Agriculture, University of Benin, Benin City. The leaves of the vegetable were destalked, washed with tap water, then rinsed with distilled water and divided into four parts of 400 g each, for various processing conditions including sun drying, oven drying, boiling against the unprocessed (raw) samples.

Sun dried samples: These samples were constantly spread under the sun for a period of 7 days, with prior turning of the leaves to prevent growth of micro-organism and for proper drying. The dried vegetables were pulverized to powder, using the Electric rotor blender (Emel, EM-242) and then stored in an air tight container for further analysis.

Boiled samples: The vegetables were blended fresh into slurry, followed by boiling in a water bath at two temperature regimes (60 and 100°C) for a period of 10 min, after which the samples were filtered and the residue stored in an air tight container in a refrigerator for further analysis. The boiled sample was recorded in dry matter basis.

Oven dried samples: The green leafy vegetables were raped in aluminum foil and heated for 10 h each at 60°C and 100°C in an electric oven. The samples were then pulverized using the electric rotor blender (Emel, EM-242) and stored in an air tight container for further analysis.

Raw samples: It is also known as the unprocessed sample, It was blended into slurry and on filtration, the residue were thus stored in a container and placed inside the refrigerator, for further analysis. The raw sample will be recorded in dry matter basis.

Assay of anti-nutritional factors: Anti-nutritional factors including phytic acid, tannins, oxalates and cyanide were determined by the following methods.

Oxalate determination: The titration method as described by Day and Underwood (1986) was followed. 0.5 g of sample was weighed into 100 mL conical flask. 15 mL 3 M H₂SO₄ was added and stirred for 1 h with a magnetic stirrer. This was filtered using a Whatman No 1 filter paper. Five milliliter of the filtrate was then taken and titrated while hot against 0.05 M KMnO₄ solution until a faint pink colour persisted for at least 30 sec. The oxalate content was then calculated by taking 1 mL of 0.05 M KMnO₄ as equivalent to 2.2 mg oxalate (Chinma and Igyor, 2007; Ihekoronye and Ngoddy, 1985).

Phytic acid determination: Titrimetric method as described by Adesina (2013) was adopted. Two gram of

the sample was soaked in 100 mL 2% HCl for 3 h and then filtered. Twenty five milliliter of the filtrate was placed in a 100 mL conical flask and 5 mL of 0.03% NH₄SCN solution was added as indicator. Fifty milliliter of distilled water was added to give it the proper acidity (pH 4.5). This was titrated with ferric chloride solution which contained 0.005 mg of Fe/mL of FeCl₃ used, until a brownish yellow colour persisted for 5 min. Phytin phosphorous (Pp) was determined and the phytic acid content was calculated by multiplying the value of pp by 3.55. Each milligram of iron is equivalent to 1.19 mg of Pp:

$$\text{Iron equivalence} = \text{titre value} \times 1.95$$

$$\text{Pp} = \text{titre value} \times 1.95 \times 1.19$$

$$\text{Therefore, phytic acid} = \text{titre value} \times 1.95 \times 1.19 \times 3.55 \text{ mg}$$

Tannin determination: The method of estimation of tannin content in extract by Joslyn (1970). was used for the determination of tannin content in the sample. Finely ground sample (0.5 g) was defatted with 5 mL petroleum ether for 15 min. The tannin in the defatted sample was then extracted with methanol and the absorbance at 760 nm was measured in a spectrophotometer (Unico Vis, 1205). The tannin content was then extrapolated from a standard tannic curve.

Cyanide determination (alkaline picrate method): Extraction of cyanide sample: this extraction is according to wang and filled method (Onwuka, 2005). About 2.5 g of sample was grinded into a paste and it was dissolved in 50 ml distilled water in a corked conical flask, this was left overnight to allow for cyanide extraction, the extract was filtered and the filtrate used for cyanide determination. Four milliliter alkaline picrate was added to 1 mL of the sample filtrate and incubated in a water bath for 5 min. After colour development (reddish brown colour), the absorbance was read in a spectrophotometer (Unico Vis 1205) at 490 nm. The absorbance of the blank containing only 1 mL distilled water and 4 mL alkaline picrate solution, the cyanide content was then extrapolated from a standard cyanide curve.

RESULTS AND DISCUSSION

Results: The results are presented in Tables 1a, 2a, 3a, 4a. The results were subjected to a one factor analysis of variance (ANOVA) at 5% significance level ($\alpha = 0.05$) as shown in Tables 1b, 2b, 3b, 4b.

From Tables 1b, 2b, 3b, 4b it is observed that the F-cal. > F-crit. at a 5% level of significance, bleeding to the rejection of the null hypothesis, this implies that we are 95% confident that there is significant difference in the different processing methods on this vegetable under consideration. This result is in line with Ekop (2007); Ifon and Bassir (1980); Embaby (2010). Also, Fig. 1 shows

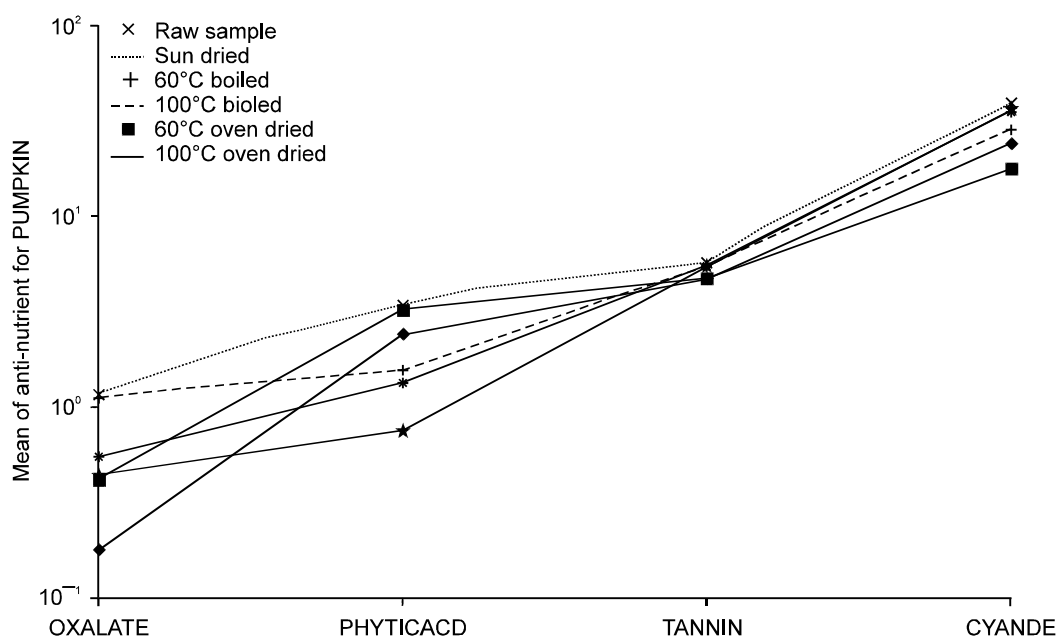


Fig. 1: Mean of Anti-Nutrient for Pumpkin Leaf against Anti-Nutrient

Table 1a: Oxalate content of pumpkin leaf (*Telfairia occidentalis*)

Oxalate content of pumpkin leaf (<i>Telfairia occidentalis</i>) (mg/100 g)				
	Rep 1	Rep 2	Rep 3	Mean
Raw sample	1.16	1.18	1.16	1.16667
Sun dried	1.1	1.12	1.1	1.10667
Boiled at 60°C	0.18	0.19	0.88	0.41667
Boiled at 100°C	0.18	0.17	0.18	0.17667
Oven dried at 60°C	0.44	0.44	0.43	0.43667
Oven dried at 100°C	0.55	0.54	0.55	0.54667

Analysis was done in triplicate, Rep 1, Rep 2, Rep 3 represent each of the triplicated analysis

Table 1b: ANOVA of oxalate content of pumpkin leaf (*Telfairia occidentalis*)

ANOVA						
Source of variation	SS	df	MS	F	p-value	F crit
Between Groups	2.42925	5	0.48585	18.06134	3.26E-05	3.105875
Within Groups	0.3228	12	0.0269	-	-	-
Total	2.75205	17	-	-	-	-

Sum of Squares (SS), Degrees of Freedom (df), Mean Square (MS), Probability of Occurrence (p-value)

Table 2a: Phytic acid content of pumpkin leaf (*Telfairia occidentalis*)

Phytic acid content of pumpkin leaf (<i>Telfairia occidentalis</i>) (mg/100 g)				
	Rep 1	Rep 2	Rep 3	Mean
Raw sample	28.43	28.35	28.35	28.37667
Sun dried	12.77	12.85	12.77	12.79667
Boiled at 60°C	26.78	26.86	26.78	26.80667
Boiled at 100°C	19.78	20.6	19.78	20.05333
Oven dried at 60°C	6.18	6.09	6.18	6.15
Oven dried at 100°C	11.04	11.12	11.04	11.06667

Table 2b: ANOVA of phytic acid content of pumpkin leaf (*Telfairia occidentalis*)

ANOVA						
Source of Variation	SS	df	MS	F	p-value	F crit
Between Groups	1211.27	5	242.254	6175.572	5.04E-20	3.105875
Within Groups	0.470733	12	0.039228	-	-	-
Total	1211.741	17	-	-	-	-

the graphical relationships between the anti-nutrients and the mean anti-nutrient contents for pumpkin leaf, respectively.

From Fig. 1, it is evidently shown that the different processing methods had a lesser value of anti-nutrient content as compared to the unprocessed (raw sample)

Table 3a: Tannin content for pumpkin leaf (*Telfairia occidentalis*)

Tannin content for pumpkin leaf (<i>Telfairia occidentalis</i>) (mg/100 g)				
	Rep 1	Rep 2	Rep 3	Mean
Raw sample	5.7	5.71	5.74	5.716667
Sun dried	5.39	5.37	5.37	5.376667
Boiled at 60°C	4.7	4.72	4.72	4.713333
Boiled at 100°C	4.65	4.66	4.66	4.656667
Oven dried at 60°C	5.41	5.4	5.4	5.403333
Oven dried at 100°C	5.5	5.51	5.5	5.503333

Table 3b: ANOVA of tannin content for pumpkin leaf (*Telfairia occidentalis*)

ANOVA						
Source of Variation	SS	df	MS	F	p-value	F crit
Between Groups	2.87625	5	0.57525	4314.375	4.33E-19	3.105875
Within Groups	0.0016	12	0.000133			
Total	2.87785	17				

Table 4a: Cyanide content for pumpkin leaf (*Telfairia occidentalis*)

Cyanide content for pumpkin leaf (<i>Telfairia occidentalis</i>) (mg/100 g)				
	Rep 1	Rep 2	Rep3	Mean
Raw sample	38.96	38.98	38.98	38.97333
Sun dried	29	28	28	28.33333
Boiled at 60°C	17.1	18	17.69	17.59667
Boiled at 100°C	23.8	23.9	23.8	23.83333
Oven dried at 60°C	36	36.2	36	36.06667
Oven dried at 100°C	36	35	35.01	35.33667

Table 4b: ANOVA of cyanide content for pumpkin leaf (*Telfairia occidentalis*)

ANOVA						
Source of Variation	SS	df	MS	F	p-value	F crit
Between Groups	1021.35	5	204.2701	1378.341	4.04E-16	3.105875
Within Groups	1.7784	12	0.1482	-	-	-
Total	1023.129	17	-	-	-	-

for pumpkin leaf (*Telfairia occidentalis*). For the oxalate content, the boiled *Telfairia occidentalis* at 100°C reduced better, for the phytic acid content, the oven dried *Telfairia occidentalis* at 60°C reduced better, for tannin content, the boiled *Telfairia occidentalis* at 100°C had a better reduction, while for the cyanide content, the boiled *Telfairia occidentalis* at 60°C reduced the anti-nutrient better.

Conclusion: Various processing methods (soaking, boiling, fermentation, sun drying, etc.) have been researched and known to reduce the anti-nutrient composition in food and food supplements. After subjecting this vegetable to various processing conditions, we hereby conclude that though all these processing conditions reduce the anti-nutrients in this vegetable when compared to the unprocessed (raw) sample, but boiling at 100°C gave a better reduction in the anti-nutrient compositions.

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