

EFFECT OF COOKING METHODS ON PROXIMATE AND MINERAL COMPOSITION OF FLUTED PUMPKIN (*TelfairiaOccidentalis*)LEAVES

Abstract

The effect of different cooking methods such as boiling, steaming and microwaving on proximate and mineral compositions of *Telfairiaoccidentalis*(Fluted pumpkin) leaves were investigated. The results obtained indicated thatat $P<0.05$ confidence level no significant losses in the values of proximate compositionoccured, except in carbohydrate with percentage reduction of 30.27%, 35.97% and 5.05% for steaming, boiling and microwaving respectively. The results of the mineral composition showed that microwaving generally retain the mineral composition than boiling and steaming. However, reduction inconcentrations of potassium was 21.7%, 90.4% and 90.4% for steaming, boiling and microwaving respectively. Steaming therefore appears the best cooking methods for*Telfairiaoccidentalis* leave andis recommended in the preparation of this vegetable for maximum nutritional benefits.

Key Words: *TelfairiaOccidentalis*, Proximate composition, Mineral composition.

1.0 INTRODUCTION

Most vegetables are commonly cooked before consumption. In general, vegetables are prepared at home, on the basis of convenience and taste preference rather than retention of nutrient and health promoting compounds [1]. It is known that cooking induces significant changes in chemical composition, affecting the bioavailability and contents of chemo-preventive compounds in vegetables. Cooking methods were shown to affect content of nutrients and health promoting compounds such as Vitamin C, Carotenoids, polyphenols and glucosinolates in broccoli vegetables [2, 3]. Processing makes food safe for consumption and destroys pathogenic microorganisms. The effect of processing on food depends on the sensitivity of the nutrient to the various prevailing conditions such as heat, oxygen, pH and light. However, it is necessary that vegetables are prepared in such a manner that retains maximum amounts of their nutrients, while losses through oxidation and leaching are highly minimized [4]. The cooking procedures such as Boiling, Steaming and Microwaving used in this research work were based on the dietary habits found amidst Nigerians.

There are many methods of cooking, most of which have been known since antiquity. These include baking, roasting, frying, grilling, barbecuing, smoking, boiling, steaming and braising. A more recent innovation is microwaving. Various methods use differing levels of heat and moisture and vary in cooking time. The method chosen greatly affects the end result because some foods are more appropriate to some methods than others. When heat is used in the preparation of food, it can kill or inactivate harmful organisms, such as bacteria and viruses, as well as various parasites such as tapeworms and *Toxoplasma gondii*. Food poisoning and other illness from uncooked or poorly-prepared food may be caused by bacteria such as pathogenic strains of *Escherichia coli*, *Salmonella typhimurium* and *Campylobacter*, viruses such as noroviruses, and protozoa such as *Entamoebahistoltylica*[5]. Parasites may be introduced through salad, meat that is uncooked or rarely cooked and unboiled water [5]. The sterilizing effect of

cooking depends on temperature, cooking time, and technique used. Studies have shown that some bacteria such as *Clostridium botulinum* or *Bacillus cereus* can form spores that survive cooking, which then germinate and re-grow after the food has cooled [6]. It is therefore recommended that cooked food should not be reheated more than once to avoid repeated growths that allow the bacteria to proliferate to dangerous level [6].

Telfairiaoccidentalis is a vegetable commonly known as fluted pumpkin in English, ugwu in Igbo language and eweroko in Yoruba language. This leaf is a tropical Vine grown in West Africa as a leafy vegetable. It is a Vegetative shrub that creeps low across the ground with large lobed leaves and long twisting tendrils. *T. occidentalis* is a vegetable which is an important food component in diets in Nigeria mostly in southern part of Nigeria. The leaf is used primarily in soups and herbal medicines, they are believe to help reduce blood pressure, improve digestion and enhance healthy metabolism. 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 rodenticides [7]. *Telfairiaoccidentalis* is traditionally used by an estimated 30 to 35 million Indigenous people in Nigeria, including the Efik, Ibibio, and Urhobo; however, it is predominantly used by the Igbo tribe, who continue to cultivate the gourd for food sources and traditional medicines [7]. The fluted gourd is noted to have healing properties and is used as a blood tonic, administered to the weak or ill. It is very common in southern Nigeria, and was an asset to international food trades of the Igbo tribe [8]. *Telfairiaoccidentalis* leaf contains nutrients which can be absorbed by the human system for body building, energy, regulatory and protective functions. They are also source of vitamins, minerals and phytochemicals. A study conducted by the Federal Institute of Technology Akure, that examined the chemical properties of the fluted gourd, concluded that the leaves containeda high amount of antioxidants, hepatoprotective and antimicrobial properties. Considered an “oil seed”, the fluted gourd is high in oil (30%) [8]. Shoots of *Telfairiaoccidentalis* contain high levels of potassium and iron, while seeds are composed of 27% crude proteins and 53% fats. The young shoots and leaves of the female plant are the main ingredients of a Nigerian soup, *OfeEgwusi*. The large (up to 5 cm), dark-red seed is rich in fat and protein and can be eaten whole, ground into powder for another kind of soup, or made into a fermented porridge.

A significant percentage of the Nigerian population consumesthis vegetable after subjecting it to one form of processing or the other. Hence, the need to evaluate the effect of the most commonly used methods of processing on the vital proximate and mineral composition of the vegetable with a view to providing useful data.

2.0 MATERIALS AND METHODS

2.1 Sample Collection and Treatment

Samples of *Telfairiaoccidentalis*used in this study were purchased from Badeggi market,Lapai, Niger state, Nigeria. Prior to analysis, the leaves were washed with tap water then rinsed with distilled water. The residual moisture was evaporated at room temperature.

2.1.1 Boiling

In this method, 200 g of homogeneous pieces of Fluted Pumpkin leaves were immersed in 400 ml of pre-heated water, which was made to boil instantly. The fluted pumpkin was drained off after boiling for 5 min.

2.1.2 Microwaving

A microwave oven (LOGIK Microwave appliance, model No: L20MS10, Tianjin Electronics, China) at full power (1000 W) for 5 min was used for microwaving. 200g of Fluted Pumpkin leaves were placed in a plate and 10 ml water was added to prevent it from burning during cooking. The Fluted Pumpkin in the plate was placed in the microwave oven for 5-min cooking, and then drained off.

2.1.3 Steaming

Steaming was conducted by suspending 200 g of cut Fluted Pumpkin leaves above 200 ml of boiling water for 5 min in a steamer with a lid

Thereafter, the leaves from the three cooking methods were oven dried at 60°C until properly dried. The dried leaves were then ground in porcelain mortar, sieved through 2 mm mesh sieve and stored in polythene bags. The powdered samples were used for both proximate and mineral analyses.

Fresh samples of the vegetable which were not subjected to any of the cooking methods were also dried at 60°C and grounded into powder for proximate and mineral analyses.

2.2 Proximate Analysis

Proximate compositions were estimated using standard methods of analysis. The moisture content of the leaves were determined by drying 5 g of the leaves (in triplicate) in a Gallenkamp oven at 105°C until constant weight was attained [9]. Ash content was determined according to the method described by [10] which involved dry ashing in lenton muffle furnace at 600°C until grayish white ash was obtained. Crude protein content was determined by multiplying the value obtained from kjeldahl's nitrogen by a protein factor of 5.3, a factor recommended for vegetable analysis. Crude lipid was quantified by the method described by [9] using the soxhlet apparatus and petroleum ether (B.P. 60°C- 80°C) as solvent. Crude fiber was determined by acid-base digestion with 1.25% H₂SO₄ (W/V) and 1.25% NaOH (W/V) solutions.

The method described in [9] was used to calculate available Carbohydrates, where the total amount of carbohydrate in the sample was obtained by calculation using percentage weight difference. This involved subtracting the percentage sum of the food nutrients, % crude protein, % crude lipid, % crude fibre, and % ash from 100% dry weight. Percentage carbohydrate was calculated using equation: Carbohydrate % = 100 – (crude protein + crude lipid + crude fibre + ash).

114 The Energy Value (calorific Value) of a Food is given by energy Value of Food (in KJ per100g)
115 = [(% available Carbohydrate X 4) + (% available Protein X 4) + (% available Fat X 9)]. [9].

116 2.3. Samples preparation for mineral analysis

117 Six (6) grams of the powdered sample was weighed into a crucible and gently heated over a
118 Bunsen burner until it charred. The charred sample with the crucible was transferred into a lento
119 muffle furnace at about 600⁰C and constantly heated until grayish white ash was obtained. It was
120 cooled first at room temperature and then in a desiccator. 5cm³ of concentrated HCl was added
121 and heated for 5 minutes on a hot plate in a fume cupboard. The mixture was then transferred
122 into a beaker and the crucible washed several times with distilled water. The mixture was made
123 up to 40cm³ and boiled for 10 minutes over a Bunsen burner. This mixture was then cooled,
124 filtered and rinsed into 100 cm³ volumetric flask and made up the volume to 100cm³ [10]. The
125 solution prepared in triplicates

126 2.4. Determination of Mineral Concentration

127 Sodium (Na) and Potassium (K) were analyzed by Flame Atomic Emission spectrophotometer.
128 Phosphorus (P) was determined with Jenway 6100 spectrophotometer at 420 nm using vanadium
129 phosphomolybdate (vanadate) colorimetric method with KH₂P0₄ as the standard [10]. The
130 concentrations of calcium (Ca), magnesium (Mg), copper (Cu), Iron (Fe), Manganese (Mn) and
131 Zinc (Zn) in the solutions were determined using Atomic Absorption Spectrophotometer AAS
132 969 (Bulk Scientific, MODEL VGB 210/211) [9].

133 2.5 Statistical analysis

134 Statistical analysis was performed using the SPSS package program version 20 (SPSS Inc.,
135 Chicago, IL, USA). Data were analyzed by one-way analysis of variance (ANOVA), followed by
136 Duncan's multiple range post-hoc test. Results are expressed as mean±SD of triplicate samples.
137 Differences were considered significant at *P*<0.05.

138 3.0 RESULTS AND DISCUSSION

139 3.1 Proximate Composition

140 The effect of different cooking methods on the proximate composition of *Telfairiaoccidentalis*
141 presented in Table 1 & 2, indicate that the values of crude fibre, Fat, Moisture and Protein
142 (except in microwaving) contents of *Telfairiaoccidentalis*increased with the various cooking
143 methods used while slight decrease was observed in the values of Ash content and
144 Carbohydrates. This generally implies that nutrients in *Telfairiaoccidentalis* leaves are enhanced
145 when cooked.

146 **Table 1: The effect of cooking methods on the proximate compositions of**
147 ***Telfairiaoccidentalis***

Cooking Methods	Moisture	Fat	Crude Protein	Crude Fibre	Ash	CHO	Energy Value
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	%	%	%	%	%	%	%
Uncooked	4.66 ±0.16 ^a	12.76±1.26 ^a	13.74±0.19 ^b	4.35±0.13 ^a	13.48±0.55 ^c	51.01±1.34 ^d	332.62±2.67 ^a
Steam	4.60±0.05 ^a	13.26±0.56 ^a	31.38±0.44 ^d	4.50±0.5 ^a	12.74±0.17 ^b	35.57±0.63 ^b	378.70±23.51 ^b
Boil	6.50±0.50 ^c	13.40±0.36 ^a	28.20±0.70 ^c	5.42±0.15 ^b	10.86±0.31 ^a	32.66±0.69 ^a	378.7±1.59 ^b
Microwav e	5.70±0.49 ^b	13.30±0.35 ^a	11.38±0.07 ^b	6.00±0.12 ^c	15.14±0.29 ^d	48.48±0.51 ^c	359.14±0.86 ^b

148 a: significant in the comparison between uncooked and cooked vegetables.
149 b: moderate significant in the comparison between uncooked and cooked vegetables.
150 c:highly significant in the comparison between uncooked and cooked vegetables.
151 d: very highly significant in the comparison between uncooked and cooked vegetables.
152

153 **Table 2: Percentage Change in Proximate Composition of *Telfairiaoccidentalis***

Proximate composition	Steaming %	Boiling %	Microwaving %	Change
Moisture	-0.43	-39.48	-22.32	Increase
Fat	-3.92	-5.02	-4.23	Increase
Protein	-128.38	-105.24	17.18	2 Increase, 1 Decrease
Fibre	-3.45	-24.60	-37.93	Increase
Ash	5.49	29.44	-12.31	1 Increase, 2 Decrease
Carbohydrates	30.27	35.97	5.05	Decrease

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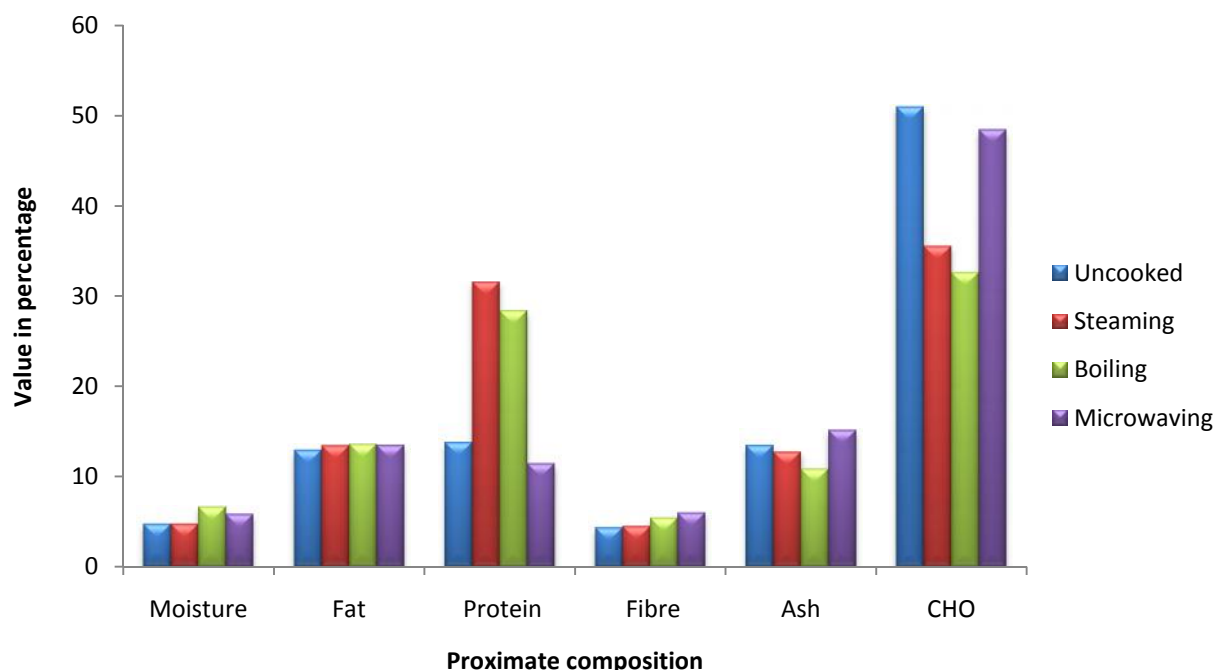


Figure 1: Showing variations between different cooking methods in proximate composition of *Telfairia occidentalis*

The result (% change) for crude protein ranges from 31.38% for steaming, 28.20% for boiling and 11.38% for microwaving. It is observed that steaming retains more of protein value, followed by Boiling this may be due to high heating temperature involve in boiling. It is reported by Rahama and Mustapha [11] that increase in temperature can cause severe protein damage in food ranging from destruction of amino acid to complete racemisation. Also, Komolafe and Obayanju [12] reported that during heating, cellular protein are denatured and chlorophyll which are bound to the protein may be released. Such free chlorophyll is highly unstable and readily converted to pheophytin, which could enhance denaturation of protein when heated. Significant decrease was observed in microwaving which may be due to internal destruction of the nutritive value of nucleoproteins.

A decreasing trend of Carbohydrate was observed at different cooking methods in the following manner Uncooked>Microwaving>Steaming>Boiling (Figure 1). Microwaving in this case retains the highest amount of carbohydrate followed by Steaming and then boiling, this may be due to the amount of heat applied. The heat applied in microwaving is not strong enough to destroy the carbohydrate content. Increased temperature reduced the carbohydrate content of vegetable and hence limits its possible usefulness as an energy source. Carbohydrate is made up of starches and sugars. Heating starches changes crystallized starch molecules into gels during which the starch granules swell and absorb water becoming soft and easier to dissolve [13].

An increasing trend of Fat content was observed in the manner Uncooked<Steaming<Microwaving<Boiling. This shows that heating enhances the Crude Fat this may be due to the increase in the extraction efficiency of crude fat by organic solvents as the rate of heating increases. Some lipids in foods are in complex lipoprotein and liposaccharides,

hence heat breaks the bond between them and the lipids are freed and solubilized in the extracting solvent [14].

3.2 Mineral Composition

The result of the effect of various cooking methods on the mineral compositions of *Telfairiaoccidentalis* is as shown in the Tables 3 & 4.

Table 3:the effects of cooking Methods on the Mineral compositions of *TelfairiaOccidentalis*

Cooking Methods	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Iron (Fe)
	%	%	%	%	%	%	Ppm
Uncooked	2.20±0.20 ^a	0.91±0.09 ^a	0.83±0.23 ^c	0.180±0.03 ^a	5.30±0.20 ^a	0.038±0.001 ^a	0.142±0.004 ^b
Steam	5.10±0.51 ^c	0.98±0.21 ^a	0.65±0.13 ^a	0.590±0.01 ^b	7.40±0.26 ^b	0.036±0.002 ^a	0.101±0.001 ^a
Boil	4.48±0.51 ^c	0.77±0.10 ^a	0.08±0.13 ^a	0.200±0.01 ^a	7.40±0.50 ^b	0.230±0.007 ^b	0.301±0.020 ^d
Microwave	1.82±0.74 ^a	1.24±0.05 ^b	0.08±0.51 ^b	0.615±0.01 ^b	7.20±0.58 ^b	0.270±0.002 ^c	0.232±0.010 ^c

a: significant in the comparison between uncooked and cooked vegetables.

b: moderate significant in the comparison between uncooked and cooked vegetables.

c:highly significant in the comparison between uncooked and cooked vegetables.

d: very highly significant in the comparison between uncooked and cooked vegetables.

Table 4: Percentage change in mineral composition of *Telfairiaoccidentalis*

Minerals	Steaming %	Boiling %	Microwaving %	Change
Nitrogen	-131.8	103.6	17.3	1 Increase 2 Decrease
Phosphorus	-7.7	15.4	-36.3	2 Increase 1 Decrease
Potassium	21.7	90.4	90.4	Decrease
Sodium	-227.8	-11.1	-241.7	Increase
Calcium	-39.6	-39.6	-35.8	Increase
Magnesium	5.3	-505.3	-610.0	2 Increase 1 Decrease
Iron	28.9	-112.0	-63.4	2 Increase 1 decrease

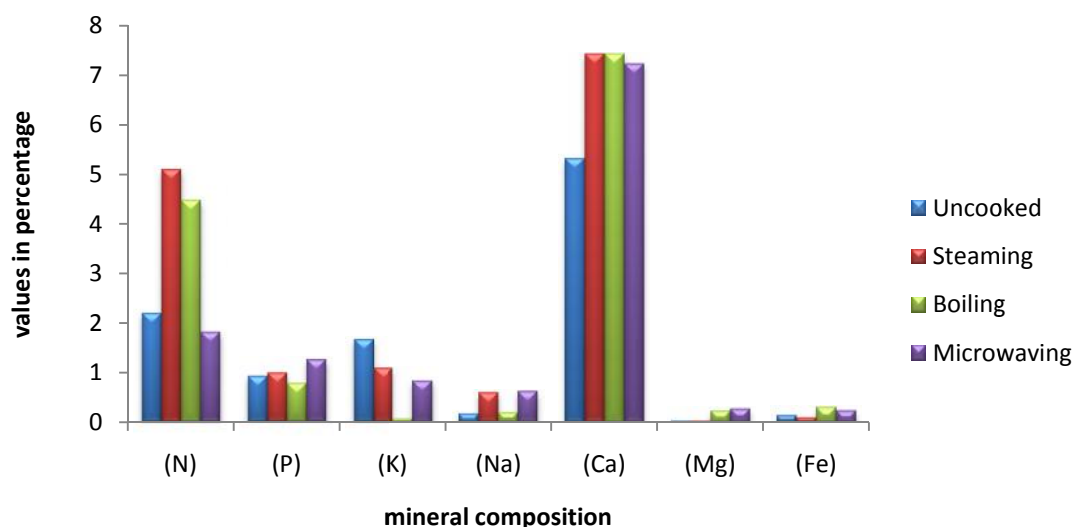


Figure 2; Showing variations between different cooking methods in mineral composition of *Telfairiaoccidentalis*

Mineral compositions of *Telfairiaoccidentalis* were greatly enhance with the cooking methods used. The percentage change of most of the minerals was seen to have increased greatly with the cooking methods.

Nitrogen had percentage increase of 131.8% when steamed and percentage reduction of 103.6% and 17.3% in Boiling and microwaving respectively.

Steaming and Microwaving were also seen to increase the level of Phosphorus by 7.7% and 36.3% respectively and percentage reduction was observed in boiling with 15.4%.

Potassium was seen to reduce in all the cooking methods used with a percentage reduction of 21.7%, 90.4% and 90.4% in steaming, Boiling and microwaving respectively.

An increasing trend was observed for Sodium and Calcium. With Sodium having 227.8% increase for Steaming, 241.7% increase for microwaving and 11.1% increase in boiling and Calcium having both steaming and boiling with 39.6% increase while microwaving has 35.8% increase(Figure 2).

The values of Magnesium and Iron were seen to increase greatly in microwaving and boiling. With Magnesium having percentage increase of 610% and 505.3% respectively, while Iron has 112.0% and 63.4% increase for both boiling and microwaving respectively.

Microwaving was generally seen to increase most of the mineral composition. This may be due to the technique used in microwaving, which involve heating the vegetables by bombarding it with electromagnetic radiation in the microwave spectrum causing polarized molecules in food to rotate and build up thermal energy. This bombardment by electromagnetic radiation in a microwave spectrum may not be strong enough to destroy some of the minerals but will rather excite the metals and make them gain more energy

4.0 CONCLUSION

This study has revealed that *Telfairiaoccidentalis* contains an appreciable quantity of nutrients, which is in compliance with previous work, but various cooking methods used affect its ash, crude protein, crude fibre, crude fat, and carbohydrate contents. Steaming however preserve most of the nutrients like Crude fat, Protein and moisture contents while boiling had a drastic effect on some of the proximate composition such as ash and carbohydrates. Microwave was seen to have minimal effect on the nutrients compare to boiling.

With regards to the mineral composition, all the cooking methods have minimal negative effect on the mineral composition of *Telfairiaoccidentalis* most of the mineral compositions were rather seen to increase with the various cooking methods used. Microwave generally has the highest percentage increase on the mineral composition followed by Steam and then boiling. Therefore to get the maximum nutritional benefit of *Telfairiaoccidentalis* leaves, microwaving and steaming are recommended.

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