Comparative Study of The Proximate, Anti- Nutritional and Mineral Compositions of Two Species of Processed and Fresh Okra Pods

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Abstract

This study aimed to conduct a comprehensive comparative analysis of the proximate, anti-nutritional, and mineral compositions of two different species of cooked okra pods and fresh okra pods. Okra is a widely consumed vegetable known for its nutritional value and potential health benefits. However, variations in processing and species may influence the nutrient and anti-nutrient contents in the pods. The study involved two species of okra, Abelmoschus esculentus and Abelmoschus caillei which were processed using a standardized method. The proximate composition, including moisture, protein, fat, ash, and carbohydrates, was determined using standard laboratory techniques. Additionally, anti-nutritional factors such as phytate and oxalates were quantified and minerals such as calcium iron, potassium and phosphorus were also quantified. Results revealed significant differences in the proximate composition of cooked okra pods and fresh okra pods. Cooked pods generally exhibited a reduction in moisture content compared to fresh pods, which was consistent across both species. Protein content slightly increased after cooking where the Abelmoschus caillei was a little higher compared to Abelmoschus esculentus, also a slight decrease in fat content was observed. Ash and carbohydrate content also experienced minor changes. The minerals content of the pods slightly differed where Abelmoschus caillei has more iron, phosphorus, and potassium while Abelmoschus esculentus had more calcium. Anti-nutritional factors in okra pods showed varying levels between species and states of cooking. Abelmoschus esculentus demonstrated higher levels of phytate in both cooked and fresh pods compared to Abelmoschus caillei. Conversely, oxalate content was considerably higher in Abelmoschus esculentus across both states of processing. Processing generally resulted in a decrease in the levels of anti-nutritional factors for both species.

Keywords: proximate, anti-nutrient, mineral content and processed

1.0 INTRODUCTION

Okra plant or lady's finger was previously included in the genus Hibiscus. Later, it was designated to *Abelmoschus,* which is distinguished from the genus Hibiscus (Aladele *et al*., 2014). *Abelmoschus* was subsequently proposed to be raised to the rank of distinct genus by Medikus in 1787. Okra originated somewhere around the Ethiopia, and was cultivated by the ancient Egyptians by the 12th century BC. Its cultivation spread throughout Middle East and North Africa. Okra is grown in many parts of the world, especially in tropical and sub-tropical countries (Arapitsas *et al*., 2013). This crop can be grown on a large commercial farm or as a garden crop. Okra plants are grown commercially in many countries such as India, Japan, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar, Malaysia, Thailand, India, Brazil, Ethiopia, Cyprus and in the Southern United States. It is grown commercially in India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus and the Southern United States.

Okro is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat and drought tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture but frost can damage the pods (Fekadu H *et al.* 2013). In cultivation, the seeds are soaked overnight prior to planting to a depth of 1-2 cm. Germination occurs between six days (soaked seeds) and three weeks. Seedlings require ample water. The seed pods rapidly become fibrous and woody, and to be edible, must be harvested within a week of the fruit having been pollinated. The fruits are harvested when immature and eaten as a vegetable. It plays an important role in the human diet and is a good source of primary and secondary metabolites such as protein, carbohydrates, vitamins, enzymes, and various minerals which are often lacking in the diet of developing country (Ogwu, M.C. and Osawaru, M.E. (2014). Its medicinal value has also been reported in curing ulcers and relief from hemorrhoids. Okra has found medical application as a plasma replacement or blood volume expander and also useful in genitor-urinary disorders, spermatorrhoea and chronic dysentery. The fruits of okra have reawakened beneficial interest in bringing this crop into commercial production. Okra has been called "a perfect villager's vegetable" because of its robust nature, dietary fiber, and distinct seed protein balance of both lysine and tryptophan amino acids. Okra is also abundant with several carbohydrates, minerals and vitamins, which plays a vital role in human diet and health (Gemede H. F, (2015). West African Okra *(Abelmoschus caillei)* belongs to the family *Malvaceae.* This Okra is indigenous to the humid West and Central Africa and is cultivated for its economic importance. It is common in traditional agricultural systems like home gardens also called kitchen garden. *A. caillei* is grown as vegetable for its leaves, fruits, seeds, floral parts and stems. In West and Central Africa, it is found almost in every market and all practicable traditional agricultural system. More so, it is found in all the political states more predominant in the South, where it shares third and fourth place with tomatoes after Capsicum pepper and Amaranthus. However, it has the widest ranges of edible parts (Osawaru and Dania-Ogbe, (2010). *Abelmoschus esculentus* which is the most common type of okra is an economically important vegetable crop grown in tropical and sub-tropical parts of the world which belongs to the family *Malvaceae*. It is apparently originated in Ethiopia, higher parts of the Anglo-Egyptian Sudan. It is widely distributed from

Africa to Asia, in Southern European, the Mediterranean and all of the America (Sorapong Benchasr (2012).

Okra is a multipurpose crop due to its various uses of the pods, fresh leaves, buds, flowers, stems and seeds. Okra immature fruits (pods), which are consumed as vegetables, can be used in salads, soups and stews, fresh or dried, fried or boiled. Despite its nutritional compositions, Okra pod is a powerhouse of valuable nutrients and affordable source of protein, carbohydrates, minerals, vitamins and dietary fiber (Ogwu, *et al.*, 2014).

On the other hand the presence of anti-nutritional factors and other harmful substances is one of the major drawbacks affecting the bioavailability of some minerals and nutritional qualities of the okra. These okra pods are mostly being consumed after they are processed, thus it is necessary to study them for their anti-nutritional composition and how processing affects them.

Today, *Abelmoschus esculentus* (Okra) is an important and common plant of tropical and subtropical in tropical and sub-tropical parts of the world as well as the *Abelmoschus caillei* in the humid West, Central Africa and other tropical regions. There usage has been reported in the traditional systems of medicine, nutrition and other areas. The introduction of exotic varieties of the common Okra led to a much reduced production of indigenous Okra as genetic enhancement have not been made for *A. caillei.* These are couple with the vulnerability of areas of its diversity and distribution specifically central Africa such as the processed okra pod, hence the need for collection and research is needed.

Therefore, the present research work was undertaken with the purpose to compare the proximate composition, anti-nutritional factors of fresh and processed okra pods to which may play a role on the bioavailability of some minerals like Calcuim, Iron and Zinc of two different species of okra which are *Abelmoschus esculentus* and *Abelmoschus caillei* of okra cultivated in Zaria local environment Kaduna state.

2.0 METHODOLOGY

2.1 Sample Collection

The okra (*Abelmoschus esculentus)* and West African Okra (*Abelmoschus caillei)* will be gotten from samar market Zaria, Kaduna.

2.2 Proximate Analysis

Methods as described by AOAC 2005 will be sed for the proximate analysis.

2.2.1 Moisture Content

Two clean crucible was dried to a constant weight in an oven at $105c^0$. It was then cooled in a desiccator and reweighed (W_1). 5g of the samples was accurately weighed into the crucible previously weighed and labeled and reweighed (W_2). (AOAC 2005) The crucible was dried in an oven to a constant weight (W_3) and the percentage moisture will be calculated using:

Moisture content = $\frac{\mathbf{W_2 - W_3}}{\mathbf{W_2 - W_1}} \times \mathbf{100}$

2.2.2 Ash content

Two clean crucible will be dried to a constant weight in an oven at $105c^0$. It will be then cool in a desiccator and weighed (W_1). 5g of the sample will be placed into the previously weighed crucible and will be reweighed (W_2). The sample will be ignited and transfer into the oven at $550c^o$. it will be left in the furnace for 4hours to ensure proper ashing. The crucible containing the sample will be removed and reweighed, (W_3) the percentage ash content will be calculated using:

Ash content = $\frac{\mathbf{W_2 - W_3}}{\mathbf{W_2 - W_1}} \times \mathbf{100}$

Ju2.2.3 Crude protein determination (formal titration method)

The sample solution (10ml) will be pipetted into a conical flask, 2drops of phenolphthalein and 0.4ml of saturated potassium oxalate solution will be added and allowed to stand for 2minutes and will be neutralize to a faint pink color with 0.1M NaOH from the burette. 2ml of the 40 formaldehyde solution will be added and continue to titrate the sample to pink color previously observed. The titration value of the second titration only will be recorded and the protein content will be calculated using:

Protein content = titre value 1.77.

2.2.4 Carbohydrate content determination

The carbohydrate content of the sample is obtained by difference that is as the difference between the total summation of percentage moisture, fat, fibre, protein, Ash and 100

Carbohydrate= 100- (moisture + ash + fat + fibre + protein)

3.3.5 Crude fibre

The sample will be weighed (5g), 100ml of H_2SO_4 solution will be added and boiled for 30minutes. It will be filtered and will behed with hot water, 100ml of NaOH solution will be added to the residue and boil for another 30minutes and filter and will bathed with hot water. The residue will be transferred to pre-weighed crucible (W_1), dry in an oven for 3hours and will be weighed (W_2), then will be ashed in a furnace for 4hours and weigh (W_3). The percentage will be calculated using:

Crude fibre (%) =(W2-W1)- (W3-W1)/weight of sample ×100

2.2.5 Crude fat determination

The sample 5g will be weighed and wrap with a plain absorbent paper. The sample will be extracted with a solvent using sohxlet apparatus for about 3hours. The oil extracted will be evaporated weighed, and the fat percentage will be calculated using:

Fat content $= wfat\ conCrude\ CrudeCrude\ fibre(\%)CrudeCrude \times 100$

2.3 Test for Anti-nutrient content

2.3.1 Determination of Phytate

The standard method of Soetan (2012) was used. The sample (4 g) was soaked in 100 cm3 of 2% HCl v/v for 5 hours and then filtered. To the 25ml of the filtrate was pipetted into a conical flask and 5ml of 0.3% ammonium thiocyanate NH4SCN) solution was added. The mixture was titrated against 0.1M FeCl3 until brownish yellow color end point that persisted for 5mins was obtained. The result was calculated as T × constant (0.1635), T =Titer value

2.3.2 Determination of Oxalic acid

Two grams of the Okra (*Abelmoschus esculentus)* and West African Okra (*Abelmoschus caillei)* sample was dissolved in 100ml of 0.75M H_2SO4 separately. The solutions were then carefully stirred with a magnetic stirrer for 1hr and filtered. 25ml of the filtrate was pippeted and titrated hot (80- 90ºc) against 0.1M $kMNO_4$ to an end point of a faint pink color that persisted for more than 30 seconds result was calculated as: T × constant (0.1635), T = Titer value

2.4 Determination of mineral contents

2.4.1 Determination of Ca, P, K, and Fe.

The digest of the ash was washed into 100 cm3 volumetric flask with distilled water and made up to mark. These diluents were aspirated into AA32ON Atomic Absorption Spectrophotometer (AAS) through the suction tube. Each of the trace mineral elements was read at their respective wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination.

3.0 RESULTS

The table 3.1 encompasses the Nutritional content of two soecie of okra pods which are the *Abelmoschus esculentus* and *Abelmoschus caillei*.

Table 3.1: Proximate Analysis of Okra Species

PARAMETERS	CB	E
OXALATE	3.083	4.
PHYTATE	2.126	2.

Parameters	CB	EB	CR	ER
Moisture	13.11	13.16	9.10	11.19
Ash	5.31	6.99	14.91	10.30
Protein	5.95	3.50	6.13	4.03
Fat	5.48	4.88	0.92	1.08
Carbohydrates	57.27	58.50	44.02	50.49
Fiber	6.454	5.458	10.6367	8.153

CB: *Abelmoschus caillei* cooked

EB*: Abelmoschus esculentus* cooked

CR: *Abelmoschus caillei* raw

ER: *Abelmoschus esculentus raw*

The table 3.2 encompasses some of the anti- nutritional content of two specie of okra which are *Abelmoschus esculentus* and *Abelmoschus caillei*.

Table 3.2: Anti- Nutritional composition

CB: *Abelmoschus caillei* cooked

EB*: Abelmoschus esculentus* cooked

CR: *Abelmoschus caillei* raw

ER: *Abelmoschus esculentus raw*

The table 3.3 encompasses some mineral composition of two specie of okra which are *Abelmoschus esculentus* and *Abelmoschus caillei*.

Table 3.3: Mineral Analysis of Okra Species

PARAMETERS	CB	EB	CR	ER
Iron (Fe)	1.22	0.93	1.94	1.01
Potassium (k)	14.85	12.33	16.71	15.92
Calcium (ca)	18.12	28.34	23.72	32.51
Phosphorus (p)	10.14	8.95	14.36	12.82

CB: *Abelmoschus caillei* cooked

EB*: Abelmoschus esculentus* cooked

CR: *Abelmoschus caillei* raw

ER: *Abelmoschus esculentus raw*

4.0 DISCUSSION OF RESULT

In the present study, the result revealed that the investigated nutrients of *Abelmoschus esculentus* were present in *Abelmoschus caillei* specie but varied in composition. The cooking process was able to significantly increase the moisture content by 6% compared to the raw pod due to the swelling of plant cells. The moisture content of *A.esculentus* cooked 13.16% and *A.caillei* cooked 13.11% was higher than the value recorded for raw okra pods where *A. esculentus* raw was 11.19% and *A.caillei* raw 9.11. The crude fiber of raw okra pods where significantly higher compared to the cooked pods where *A.esculentus* raw was 22.91%, *A.caillei* raw 24.930%, *A.esculentus* cooked 12.97% and *A.caillei* cooked 12.88%. During cooking, some of the fiber content in the okra pod are released in the water which explains the reason for the higher value in raw pods. Crude fiber protects the body against colon cancer, diabetes and cardiovascular illnesses. It provides bulk to food to relieve constipation (Gemede *et al.*,2015). Fiber in the diet is also important as it helps to maintain human health by reducing cholesterol levels in the body. The ash contest of the raw okra pods where also significantly higher compared to cooked where *A.esculentus* raw was 10.30% *A.caillei* raw 14.91% *A.esculentus* cooked 6.99% *A.caillei* cooked 5.31%. The ash content in the sample indicates the percentage of inorganic minerals present. The fat content in boiled pods where higher compared to the raw where A.*esculentus* raw 1.08%, A.*caillei* raw 0.91%, A.*esculentus* cooked 4.88%, A.*caillei* cooked 5.48%.

The protein content for the *Abelmoschus caillei* specie where significantly higher than the *Abelmoschus esculentus* as A.*esculentus* raw had 4.030%, A.*esculentus* cooked 5.95%, A.*caillei* raw 6.13%, A.*caillei* cooked 5.95%. Protein is a significant constituent which promote growth in body system and build up the body. For carbohydrates content A.*esculentus* raw was 50.49%, A.*caillei* raw 44.02%, A. *esculentus* cooked 58.5% and A.*caillei* cooked 57.27% which shows that the cooked pod has a significant high carbohydrate value.

Minerals are considered to be essential in human nutrition. Minerals are vital for the overall mental and physical wellbeing and are important constituents of bones, teeth, tissues, muscles, blood and nerve cells. They help in the maintenance of acid-base balance, response of nerves to physiological stimulation and blood clotting. The calcium content of A. *esculentus* cooked was 28.34 mg/g A.*esculentus* raw 18.49 mg/g which is more higher compared to *Abelmoschus caillei* specie which has 18.12mg/g for A.*caillei* cooked and 23.72mg/g for A.*caillei* raw .Calcium is a constituent of bones and helps in muscle contraction, blood clotting and nerve transmission (Ogwu *et al.,*2014). When the calcium supplied to the body becomes insufficient, the body extracts the needed calcium from the bones. If the body continues to draw more calcium than it replaces over a period of years, the bones will become weak and break easily.

Okra pods contains iron which is an important component of haemoglobin in the red blood cells and myoglobin in the muscle. It helps in the formation of blood and in the transfer of oxygen and carbon dioxide from one tissue to another. The *Abelmoschus caillei* had a higher iron concentraton where *A.caillei* cooked had 1.22 mg/g and *A.caillei* raw 1.94 mg/g while *A. esculentus* cooked 0.93mg/g and *A.esculentus* raw 1.01mg/g. The concentration of phosphorus in *Abelmoschus esculentus* was lower than the value of callei where by *A.caillei* cooked had 10.14 mg/g *A.caillei* raw 14.36 mg/g *A. esculentus* cooked 8.95mg/g and *A.esculentus* raw 12.82 mg/g. Potassium content of *Abelmoschus caillei* was higher than *Abelmoschus esculentus* where *A.esculentus* cooked had 14.85 mg/g *A.caillei* raw 16.71 mg/g and *A.esculentus* cooked 12.33 mg/g A. *esculentus* cooked 15.92 mg/g. Potassium is a significant body mineral, important to both cellular and electrical functions. High concentration of potassium in the body was reported to increase iron utilization and was beneficial to people taking diuretics to control hypertension and excessive excretion of potassium through the body fluid. The raw okra pods possess higher level of mineral nutrients compared to the cooked

Phytate is a very stable and potent chelating food component that is considered to be an anti-nutrient by virtue of its ability to chelate divalent minerals and prevent their absorption (Gemede *et al.,*2015). For this research the phytate content in the boiled okra was seen to be less as compared to the raw where the *A. esculentus* cooked was 2.126% *A. esculentus* cooked 2.060% *A.caillei* raw 3.172% *A.esculentus* raw 3.254% After cooking the okra the phytate content is said to reduce because of the effects of heat.

Oxalates can have a harmful effect on human nutrition and health, especially by reducing calcium absorption and aiding the formation of kidney stones. High-oxalate diets can increase the risk of renal calcium oxalate formation in certain groups of people. For this research the oxalate content of the *Abelmoschus caillei* specie was observered to be lower than the cooked and raw *Abelmoschus esculentus* where *A.esculentus* raw was 5.85% *A. esculentus* cooked 4.523% and for *Abelmoschus caillei* cooked and 3.083% *Abelmoschus caillei* raw 3.5%. The effect of boiling is very beneficial as it reduces the oxalate concentration in the okra pods.

5.0 CONCLUSION

This study indicates that there are significant differences in the proximate and mineral composition of the okra specie and boiling has a significant effect on these compositions. The pods of *Abelmoschus caillei* are found to be a good source of crude protein, crude fat, crude carbohydrate when cooked, fiber, calcium, iron and potassium which could contribute usefully to the amounts of diet. The *Abelmoschus caillei* has a good nutritional profile with high levels of crude protein, crude fat and minerals, whereas *Abelmuscus esculentus* is high in calcium, iron and carbohydrate and thus is useful to breeders for further improvement. The anti-nutritional contents of *Abelmoschus caillei and Abelmoschus esculentus* okra pods where moderately low meanwhile *Abelmoschus caillei* had a lower anti-nutritional concentration, the effect of boiling was also beneficial as it reduces the anti-nutritional content.

Hence, increasing the production and consumption of these nutrient rich underutilized indigenous okra pods which will help in food fortification, dietary diversification and alleviation of problems associated with malnutrition in the families, communities and the country at large.

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