The Effect of Blanching on the Nutrients and Anti-Nutritional Factors of the Leaves of Tender and Mature *Bombax c.*

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ABSTRACT

***Background:** Vegetables being the edible parts of herbaceous plant mostly consumed by man and animals have varying nutritional compositions. They provide rich sources of vitamins and minerals. In Nigeria most vegetables are eaten after processing which may be blanching or steaming.*

***Objective**: The objective of this study is to determine the effect of blanching on the nutrients and anti-nutritional factors of the leaves of tender and mature Bombax costatum.*

***Methods**: An experimental study design was adopted. The leaves of tender and mature Bombax costatum were analysed in raw and blanched forms using the methods described by AOAC [1]. The student's T-Test was used to statistically analyse the data.*

***Results**: The results show that tender Bombax costatum had a high moisture content (72.60±0.50), (P 0.05), which significantly increased with blanching (81.32±2.11). For tender Bombax costatum the blanching process led to a reduction in the fat (from 3.54±0.08 to 2.22±0.63), anti-nutritional factors and the vitamins as well as sodium, calcium, iron and phosphorus contents significantly (P 0.05).*

***Conclusion**: Blanching led to a significant reduction in the sodium, calcium, iron and phosphorus contents of the tender Bombax costatum. The mature vegetables were found to be high in calcium contributing more than a 100% of RDA per 100g serving.*

Keywords: Anti-nutrients, blanching, *Bombax costatum*.

INTRODUCTION

Dietary diversification is widely accepted as an efficient long-term strategy to combat micronutrient malnutrition [2], hence, efforts are being geared towards increasing utilization of local foods [2, 3]. The campaign on the regular consumption of varieties of fruits and vegetables has become popular. Such campaigns are further buttressed by the availability of data on the nutritional qualities of these fruits and vegetables. Scholars [4], [5] and [6] have reported that green leafy vegetables are rich sources of micronutrients. While some others [7] and [8] reported that these micronutrients are mostly bound by some chemical compounds called anti-nutritional factors thus, reducing the bioavailability of such nutrients. It has been suggested that processing can help release these bound nutrients [2]. This statement was further corroborated by further studies [8, 9] with their position that food preparation and processing techniques have been shown to reduce the anti-nutrients in many vegetables. For this reason, this study investigated the leaves of *Bombax costatum* which are used in the preparation of different local dishes. They are used both in the tender and mature forms.

There is limited information on the nutrient composition of this plant in literature. In the food Composition Table for use for Africa, another variety (*Bombax buonopozense B. angulicarpum*)

of this plant was reported, the moisture content was shown to be 80.0%, protein content was 3.4% while fat content was 0.6%.

In recent times, studies have shown that leafy vegetable have increasingly gained recognition as essential part of daily diet. The health benefits derived from the consumption of leafy vegetables cannot be over emphasized. The need to also explore the health potentials of these vegetables becomes expedient to avoid undue usage. Information from such exploration becomes useful for their proper utilization. Several studies have indicated that it is beneficial to consume a variety of vegetables on a daily basis [4]. In over a week's time a variety of vegetables should be eaten especially green and orange vegetables and also, about five to nine servings per day may be beneficial [4]. Vegetables contain a lot of vitamins and minerals which are essential to health although, in some cases their use is being restricted, for example controlling blood phosphorus and calcium levels in renal failure may help slow the progression of the disease and help prevent bone disease [10]. Sequel to this, it becomes expedient to study a lot of our indigenous underutilized vegetables. This will provide data for a host of investigators, scholars and dieticians to aid their work. *Bombax costatum* is one of such vegetables. Thus, this study will provide information on the effect of blanching on the nutrients and anti-nutritional factors of the leaves of tender and mature *Bombax costatum*.

Description of the Plant

*Bombax costatum Pellegr.*and *Vuill*. is a tropical plant. It is from the family Bombacaceae, genus *Bombax* [11]. The leaves resemble those of *Manihot esculenta* (cassava). The International Centre for Research in Agroforestry [11] described *B. costatum* as a tree that is fire resistant from the savannas and dry woodlands from Senegal to Central Africa, from Guinea to Ghana and Nigeria to southern Chad. It has tuberous roots which act as water and/or sugar storage facilities during long seasons of drought. This plant is usually associated with *Pterocarpus erinaceus*, *Daniellia oliveri*, *Cordyla pinnata*, *Parkia biglobosa*, *Terminalia macroptera* and *Prosopis Africana I* [11] It has biophysical limits such as soil type. It thrives well in stony soils. Its flowering is usually after leaf fall in November to February. It fructifies, according to site and conditions, from the sixth year on, but very irregularly. Fruit formation begins around August to September. The leaves of this plant could be used either in the tender state (opening buds) or allowed to mature. The mature ones are tougher and most times dried and ground to powder before use for longer shelf life. Both types are slimy when used. Local sources (informal interviews) indicated that they are used in soup preparation to eat cooked yam flour (amala), cooked maize flour (tuwo masara) or any other solid staples. Another source also said that it provided a healthy and rich source of nutrients during the Biafrian War especially in the Eastern part of Nigeria. It is known as "eegun" in Yoruba. Thus, this study tried to determine the effect of blanching on the nutrients and anti-nutritional factors of the leaves of tender and mature *Bombax costatum*.

MATERIALS AND METHODS

This study was designed to determine the effect of blanching on the nutrients composition and selected anti-nutritional factors of '*Bombax costatum*'. The edible portion of the tender and mature vegetables were picked and cleaned properly. Each vegetable was shared into two parts and each part was blanched; the other was analyzed raw. The vegetables were cleaned, dried, and pulverized. These pulverised samples were thereafter packed in air-tight plastic containers and stored, from where portions were drawn for analysis. Duplicate copies were analyzed for each sample of the vegetable. Moisture content and Vitamin C were analyzed on wet (fresh) sample before drying. Other parameters were analyzed on dried sample and converted to wet matter basis using the standard method given by AOAC (1995). The edible portion of the green leafy vegetables was used.

Saponin was determined using the method of [12] tannin was determined by the method of Folin-Deins spectrophotometric method [13]. Oxalate was determined using Oxalate determination procedure [14] while phytate content was determined by the method of [15]. All these determinations were done in triplicates.

Test of significance was carried out using student's T Test at 5% level of significance, ($P = 0.05$).

RESULTS

Table 1 below shows the proximate composition of tender and mature *Bombax costatum* leaves in wet matter. There was a significant increase (from 72.60 ± 0.50 to 81.32 ± 2.11 and from 62.80 ± 0.86 to 72.05 ± 0.76 respectively) in moisture content after blanching in the two vegetables. The protein content (7.19 ± 0.04)

experienced a significant reduction (5.58±0.24) in the mature vegetable however, the fat content was not significantly affected by the blanching process. Whereas blanching led to a significant reduction in the fat (from 3.54±0.08 to 2.22±0.63) and carbohydrate (from 13.21±2.34 to 6.90±1.48) content of the tender vegetable. The crude fibre and the ash contents were not significantly affected by blanching in the tender vegetable but the mature form of the vegetable experienced a significant reduction in these nutrients.

The mineral contents of the tender and mature forms of the vegetable are presented in table 2. It shows that blanching led to a significant reduction in Sodium (from 91.80±24.56 to 15.81±1.50), Calcium (from 683.18±33.38 to 327.56±23.03), Iron (from 2.39±0.37 to 1.51±0.16) and Phosphorus (from 0.72±0.00 to 0.51±0.01) in the tender vegetable while a reduction but not significant occurred in Potassium. Blanching led to a significant reduction in Potassium and Phosphorus and a significant increase in Iron content (from 0.00±0.00 to 2.80±0.02) of the mature vegetable.

Table 1: Proximate composition of tender and mature *Bombax costatum* in g/100g wet matter.

VF	Sample	Moisture	Protein	Fat	CHO	Crude Fibre	Ash
Tender	**Raw Bombax costatum**	72.60±0.50	4.46±1.90	3.54±0.08	13.21±2.34	3.59±0.00	2.62±0.35
	Blanched Bombax costatum	81.32±2.11	3.61±0.53	2.22±0.63	6.90±1.48	2.87±1.00	1.62±0.33
	P value	0.03	0.60	0.00	0.08	0.42	1.00
Mature	**Raw Bombax costatum**	62.80±0.86	7.19±0.04	4.42±0.18	15.34±0.01	5.94±0.21	4.18±0.27
	Blanched Bombax costatum	72.05±0.76	5.58±0.24	4.24±0.30	10.96±0.03	4.54±0.01	2.95±0.16
	P value	0.01	0.01	0.55	0.00	0.01	0.03

Significant at $p < 0.05$. VF = Vegetable form, CHO = Carbohydrates

Table 2: Mineral content of tender and mature *Bombax* costatum in mg/100g wet matter.

VF	Sample	Sodium	Potassium	Calcium	Iron	Phosphorus
Tender	**Raw *Bombax costatum***	91.80±24.56	391.87±27.48	683.18±33.38	2.39±0.37	0.72±0.00
	Blanched *Bombax costatum*	15.81±1.50	339.31±24.17	327.56±23.03	1.51±0.16	0.51±0.01
	P value	0.03	0.18	0.01	0.09	0.00
Mature	**Raw *Bombax costatum***	22.87±4.48	242.86±7.54	1237.50±154.8	0.00±0.00	1.51±0.04
	Blanched Bombax costatum	14.51±0.31	178.68±26.04	1048.50±35.04	2.80±0.02	0.87±0.09
	P value	0.12	0.08	0.24	0.00	0.01

Significant at $p < 0.05$. VF = Vegetable form

Table 3: Anti-nutritional factors of tender and mature *Bombax costatum* in mg/100g wet matter.

VF	Sample	Saponin	Tannin	Oxalate	Phytic Acid
Tender	**Raw Bombax costatum**	18.00±0.00	15.00±0.00	19.00±1.4	21.00±1.41
	Blanched Bombax costatum	13.50±0.71	4.00±0.71	12.00±1.4	11.00±1.41
	P value	0.12	0.00	0.04	0.02
Mature	**Raw Bombax costatum**	22.00±0.00	18.00±0.00	35.00±1.41	26.50±1.41
	Blanched Bombax costatum	18.00±0.71	6.50±0.71	12.00±1.41	15.50±1.41
	P value	0.00	0.00	0.00	0.02

Significant at $p < 0.05$. VF = Vegetable form

Table 4: The beta-carotene and vitamin C content of tender and mature *Bombax costatum* in wet matter.

VF	Sample	β –Carotene (µg/100g)	Vit. C mg/100g
Tender	**Raw *Bombax costatum***	750.00±1.14	32.50±0.00
	Blanched *Bombax costatum*	650.00±0.00	17.80±0.28
	P value	0.00	0.00
Mature	**Raw *Bombax costatum***	1242.50±10.61	26.25±0.35
	Blanched *Bombax costatum*	1175.00±35,36	15.00±0
	P value	0.02	0.00

Significant at $p < 0.05$. VF = Vegetable form

The Anti-nutritional factors of tender and mature *Bombax costatum* leaves presented in table 3 indicates that blanching led to a significant reduction in all the anti-nutritional factors analysed in the two forms of vegetables.

The beta-carotene and vitamin C content of tender and mature *Bombax costatum* is presented in table 4 below. Blanching led to a significant reduction in the beta-carotene and vitamin C content of tender and mature *Bombax costatum*.

DISCUSSION

The proximate composition of the tender *Bombax costatum* showed that the moisture content of this vegetable was significantly affected by blanching (P 0.05). The process caused an increase in the moisture content of the vegetable due to water absorption during the blanching process. The high moisture content indicates high perishability and bulkiness. The moisture content was observed to be lower than the moisture content of most raw vegetables found in Food Composition Table for Use in Africa [16] and organically grown fluted pumpkin [17], but higher than the moisture content of *Hibiscus cannabinus* and *Haematostaphis barteri* [18]. These differences in the moisture content can be due to variations in species of vegetable and the stage of maturity of the plant. The protein content of this vegetable aligns with the range of values of the protein contents found in the Food Composition Table for Use in Africa [16], but lower than the values for protein in some non-conventional leafy vegetables [18] and organically grown Fluted Pumpkin [17]. The fat content was observed to be high. This may be the reason for the slimy nature of the vegetable. The fat content was higher than those reported in the Food Composition Table [16], *Hibiscus cannabinus* and *Haematostaphis barteri* [18] and organically grown fluted pumpkin [17]. The raw and blanched forms of this vegetable provide about 5.33% and 4.7% RDA for fat in a 100g serving for a healthy adult. The crude fibre content of this vegetable is lower than the crude fibre content in *Hibiscus cannabinus* and *Haematostaphis barteri* [18] and higher than the crude fibre content of organically grown

Fluted Pumpkin [17]. The ash content of the raw vegetable was within the range of values of some antidiabetic medicinal plants [19]. These differences may be because varieties of vegetables have varying nutrient composition and the stage of maturation of the plant may also affect the nutrient composition.

Whereas, the proximate composition of mature *B. costatum* shows that the vegetable contains high moisture content which is lower than most of the values for moisture content found in the Food Composition Table [16] It also implies that this vegetable is highly perishable and bulky. The crude fibre content was high. This could be due to the age of the vegetable. The fat, protein and carbohydrate contents were observed to be higher than the values reported in the Food Composition Table, [16] and pumpkin leaves in USDA nutrition facts [20]. The ash content was high indicating a high mineral content. A hundred gram of the vegetable could contribute about 7.96%, 4.25% and 8.45% RDA to a 70kg adult male for protein, fat and carbohydrate in the raw form while 100g of the blanched form could contribute 6.45%, 2.66% and 4.42% RDA respectively.

Blanching led to a significant reduction in the sodium, calcium, iron and phosphorus contents of the tender *Bombax costatum*. The potassium content did not significantly reduce. The sodium and calcium content of this vegetable were higher than the values in pumpkin leaves in USDA nutrition facts [20] but the potassium content was within the range reported for the raw vegetable. The iron and phosphorus content of this vegetable were lower when compared with the values in pumpkin leaves in USDA nutrition facts [20]. Their contributions to RDA in 100g serving are 1.52%, 5.17%, 103%, 0% and 0.22% respectively for the raw and 0.97%, 3.87%, 87.38%, 15.56% and 0.12% respectively for the blanched.

The mineral content of the mature vegetable show that the vegetable is high in calcium contributing more than a 100% of RDA in a 100g serving. It was observed to be low in phosphorus in fact lower than the values found in pumpkin leaves in USDA nutrition facts [20]. The iron content of this vegetable was not available (in the zero range) in the raw form but was found to have increased to 2.39mg/100g after blanching that is, made more available but is far lower than organically grown fluted pumpkin [17]. This increase in iron content supports the statement made by some researchers [21] thus, phytic acid as an anti-nutrient, complexes with certain minerals such as iron. This means that phytic acid will bind to these minerals, reducing their availability to serve nutritional needs but the mineral can be released with thermal treatment. The unavailability of this mineral is an issue of concern to some nutrition experts, as it presents a potential risk of nutrient deficiencies. From a practical perspective, this has a great potential to affect vegetarians, pregnant women, and the extremely malnourished who consume vegetables raw, due to their generally low mineral consumption [22] especially in the rural areas.

The beta-carotene content of tender *Bombax costatum* was higher than the "high category" vegetable group classified by some Indian scholars [23] for beta-carotene levels in vegetables. The beta-carotene and vitamin C contents were significantly reduced by blanching (P 0.05). It was found that the vitamin C content of this vegetable was higher than vitamin C content of some other raw pumpkin leaves [20] It contributes about 31.11% and 19.78% of the RDA in a 100g serving of the raw and blanched form of this vegetable.

Whereas, the beta-carotene content of the mature vegetable was found to be higher than the "high' beta-carotene" category. Vegetables with high β-carotene level have up to 46 to 74μg/g of β-carotene. Vegetables with moderate β-carotene level have 25 to 39μg/g leaf. Vegetables with low β-carotene level have 12 to 23μg/g leaf. This classification was done by some authors from India [23]. The vitamin C content was significantly reduced by blanching (P 0.05). It is higher than vitamin C content of some raw pumpkin leaves [20]. It contributes about 29.0% and 16.0% of the RDA in a 100g serving of the raw and blanched form of this vegetable.

CONCLUSION

This study is an asset. It provides information on the nutrients and selected anti-nutritional factors including some vitamins and minerals of the leaves of *Bombax costatum* (tender and mature). Also, it shows the effect of blanching on these components in these vegetables since most of them are eaten blanched or cooked.

RECOMMENDATONS

1. For a widespread consumption of this vegetable efforts should be made to cultivate this under-utilized crop and bring them to the market.

2. The vegetables especially at maturity can be dried, ground and stored in air-tight containers. This has been practiced by local consumers and found to be effective.

AREAS FOR FURTHER RESEARCH

For further studies, Flavonoids are a group of polyphenolic compounds ubiquitously found in fruits and vegetables and are good transition metal chalators [24]. There is a dare need to explore the other flavonoides content of these vegetables in order to fully establish its full usefulness. Their activities include: free radical scavenging, vaso-dilatory, anti-allergic, anti-viral, oextrogenic effect [25] as well as being inhibitors of phosphor-lipase and so on. It is also necessary to determine the amino acid profile of these vegetables, since a lot of people now turn vegetarians and depend on these leafy vegetables to complement their protein sources.

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