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COMPARATIVE PROXIMATE, PHYTOCHEMICAL AND MINERAL COMPOSITION OF RAW AND BOILED *BORASSUS AETHIOPUM* MART

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***Key words**: Borassus aethiopum, seed shoot, proximate, phytochemical, mineral composition, nutrition.*

***ABSTRACT:** Comparative screening of proximate, phytochemical and mineral contents of raw and boiled Borassus aethiopum was conducted. Seed shoot samples used in the study were obtained from a farm site in Akpacha, Omala Local Government Area of Kogi State, Nigeria. For each sample, 100g of the seedlings or hypocotyls were washed, rinsed (raw samples), and boiled for 30 minutes (boiled samples). Standard methods were used for assessment of the raw and boiled samples each in ten replicates. The results, obtained from the data, subjected to a one way ANOVA showed significant differences (P< 0.05) between the means of the raw and boiled samples in moisture, crude fibre, ash content, crude fat and carbohydrate. Crude proteins of the raw and boiled samples showed no significant differences. There was significant differences in the means of the raw and boiled samples in Phytate, Oxalate, Flavonoid, Saponin and Alkaloid contents. There was no significant differences (P> 0.05) in tannin and phenol contents of both the raw and the boiled samples. There was significant differences (P< 0.05) in the mineral contents of the raw and boiled samples. Except in the case of Potassium that decreased on boiling, Iron, Zinc, Copper, Magnesium, Manganese, Phosphorous and Sodium contents increased on boiling. The implications of the results on human nutrition were discussed.*

INTRODUCTION

There are many debates on the preference of raw diet over the boiled one. Some people believe that eating raw foods means getting more nutrients. Some believe that cooking food kills the natural enzymes in plants, as well as the constituent vitamins and minerals. However, it is equally known that while boiling may cause loss of some nutrients, others become available on boiling (Zongo et al., 2019). *Borassus aethiopum* is a species of palm from Africa, belonging to the family Arecaceae. In

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English, it is commonly referred to as African fan palm, African Palmyra palm or Toddy palm. It is widely distributed in the Guineo-congolian altitudes along rivers and in coastal woodlands (Zongo *et al*., 2018). In Eastern and Central-eastern Burkina Faso it is called *koboula*. The plant can tolerate high temperatures and will grow in areas with rainfall less than 500mm per year if the ground water table is high. It is often in dense stands. *B. aethiopum* is a popular palm tree in Nigeria. Locally, the Hausa people call it *Giginya*, the Fulanis call it *Dubbe*, and the Yorubas call it *Agbon Oludu* while the Kanuris call it *Kemelutu* (Waziri *et al*., 2011). The young germinating shoot (hypocotyl) of the plant is called *Muruchi* in Hausa and *Odo* in Igala language. Among the Igala where this study was carried out, the boiled germinating shoot is widely consumed whereas less of the raw processed is known. Young shoots of *B. aethiopum* are obtained 6 to 8 weeks after germination of mature fruits, each fruit giving rise to an average of 3 shoots (Michel *et al*., 2013).

The uses of the various parts of the plant has been severally reported (Akinniyi *et. al.,* 2000, ; Nakkeeran and Shankar, 2017; Zongo *et al*., 2018, 2019). Traditional societies have always exploited edible wild plants to provide adequate nutrition, food security and income generation (Akubugwo *et al*., 2008, 2007 a,b., ; Antia *et al*., 2006, Dhellot *et al*., 2006a,b). As pointed out by Aina (2018), these wild plants not only serve as vital constituents of human diet, supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy, but also provide raw materials for industries. There is a general awakening to natural products for both food, therapeutic and/or prevention of diseased conditions. Through phytochemical screening, the ethno medicinal, analgesic, cardio protective, hypoglycaemic, and other pharmacological properties of plants are established. When the diet is of natural origin and contains required phyotchemicals, minerals and vitamins, diseased conditions are prevented in the body.

Interestingly, the palmyra has caught the attention of researchers over the past decade. The proximate values and mineral content of the shoot of *B. aethiopum* were determined by Akinniyi *et al.* (2000). Waziri *et al.* (2011) has also studied the ash content of food condiment (*Dalang*) made from *B. aethiopum*. Michel *et al.* (2013) studied the physicochemical characterization, enzymatic and rheology of the flour of young shoots of *B. aethiopum*.Nakkeeran and Shankar, (2017) studied the proximate and mineral contents of raw and boiled *Borassus flabellifer* Linn. They concluded that raw and boiled scale leaf samples of *B. flabellifer* have significantly different proximate and mineral contents, the boiled Palmyra scale leaf sample having higher proximate percentage than the raw sample. Their results also showed that the minerals content of the raw sample was higher than that of the boiled one. Zongo *et al.* (2018) demonstrated the dietary utilization of both raw and boiled Palmyra seedling in the eastern and central eastern regions of Burkina Faso. Zongo *et al.* (2019) carried out a study of the proximate and mineral contents of raw and boiled samples of the hypocotyls of *B. aethiopum* Mart. from Eastern and Central-

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eastern of Burkina Faso. Their study revealed that the sample is richer in carbohydrate than protein and had a very low lipid content. The zinc and iron contents were also low. Higher water content was found in the fresh sample compared with the boiled. This study was aimed at comparative analysis of the proximate, phytochemical and mineral composition of raw and boiled seed shoot samples of *Borassus aethiopum* Mart. from Kogi East, North Central Nigeria.

a *b* *c*

Figure 1a-c: Shoot of B. aethiopum

MATERIALS AND METHOD

Young shoot samples (Figure 1a-c) of *B. aethiopum* (Figure 2) were collected from farmers in a farm settlement in Akpacha, Omala Local Government Area, Kogi State, Nigeria. The vegetation type in the area of sample collection is that of a derived Savanna.

Figure 2: B. aethiopum Tree

Treatment of boiled samples involved washing of the ten raw seed shoots and boiling them for 30 minutes while_the raw samples were only washed. Both the raw and boiled samples were sliced into different plates and labeled. Standard procedures were employed for the determination of the Mineral elements, Proximate and phytochemical composition. Parameters evaluated in the proximate analysis included: Moisture content, Crude fibre, Crude protein, Ash content, Crude fat and Carbohydrate. For the Mineral composition, the presence of Iron, Zinc, Copper, Magnesium, Manganese, Phosphorus, Sodium and Potassium were evaluated in the samples. For the Phytochemical analysis, Tannin, Phenol, Phytate, Oxalate, Flavonoid, Saponin and Alkaloid were evaluated.

Data generated from the analyses were subjected to one way analysis of variance (ANOVA) using SPSS version 16.0. Mean comparison was obtained using Least Significant Difference (LSD) analysis.

RESULTS AND DISCUSSION

Results obtained from the various analyses are presented in the tables below.

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Table 1: Relative Proximate Composition of Raw and Boiled *B. aethiopum*

PARAMETER	RAW	BOILED	LSD VALUE
MOISTURE CONTENT	64.16 ± 0.71[a]	68.91 ± 0.62[b]	0.019
CRUDE FIBRE	4.06 ± 0.13[a]	5.66 ± 0.06[b]	0.004
CRUDE PROTEIN	14.56 ± 0.12[a]	14.50 ± 0.11[a]	0.684
ASH CONTENT	2.94 ± 0.09[a]	2.04 ± 0.23[b]	0.034
CRUDE FAT	3.08 ± 0.13[a]	1.25 ± 0.01[b]	0.003
CARBOHYDRATE	11.72 ± 0.22[a]	9.16 ± 0.15[b]	0.005

The data are mean values ± standard deviation (SD) duplicates; means with the same superscripts for the raw and boiled samples are not significantly different while values with different letter(s) within the column are significantly different.

Table 2: Relative Phytochemical Composition of Raw and Boiled *B. aethiopum*

PARAMETER	RAW	BOILED	LSD VALUE
TANNIN	3.87 ± 0.20[a]	4.44 ± 0.43[a]	0.234
PHENOL	4.25 ± 0.09[a]	3.84 ± 0.18[a]	0.108
PHYTATE	99.23 ± 0.67[a]	27.61 ± 0.59[b]	0
OXALATE	6.71 ± 0.06[a]	4.91 ± 0.06[b]	0.001
FLAVONOID	0.89 ± 0.01[a]	1.42 ± 0.07[b]	0.009
SAPONIN	0.34 ± 0.02[a]	0.25 ± 0.01[b]	0.014
ALKALOID	1.02 ± 0.02[a]	0.76 ± 0.01[b]	0.005

Results are mean values ± standard deviation (SD) duplicates, mean with the same superscripts are not significantly different while values with different letter(s) within the column are significantly different.

Table 3: Relative Mineral Composition of Raw and Boiled *B. aethiopum*

PARAMETER	RAW (PPM)	BOILED (PPM)	LSD VALUES
IRON	32.27 ± 2.98[a]	43.75 ± 2.19[b]	0.048
ZINC	1.51 ± 0.19[a]	1.32 ± 0.56[b]	0.694
COPPER	2.60 ± 0.20[a]	4.52 ± 0.35[b]	0.021
MAGNESSIUM	391.07 ± 33.50[a]	450.34 ± 7.13[b]	0.134
MANGANESE	8.89 ± 1.00[a]	11.11 ± 0.01[b]	0.089
PHOSPHORUS	2.09 ± 0.10[a]	2.51 ± 0.23[b]	0.138
SODIUM	309. 71 ± 69.66[a]	449.42 ± 24.09[b]	0.116
POTASSIUM	26894 ± 2557.73[a]	18197 ± 736.81[b]	0.044

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The data are mean values ± standard deviation (SD) duplicates, mean with the same superscripts are not significantly different while values with different letter(s) within the column are significantly different.

DISCUSSION

It is important to consume the seven major nutrients and required minerals on daily basis and in the right proportions to build and maintain health. Deficiencies, excesses and imbalances in diet can impact negatively on health, which may lead to diseases such as cardiovascular disease, diabetes, scurvy, obesity, or osteoporosis as well as psychological and behavioral problems. According to the reports of the United Nations World Health Organization (WHO, 2012), more than starvation, the real challenge in developing nations today is malnutrition-the deficiency of micronutrients (vitamins, minerals and essential amino acids) that no longer allows the body to ensure growth and maintain its vital functions.

Proximate Composition

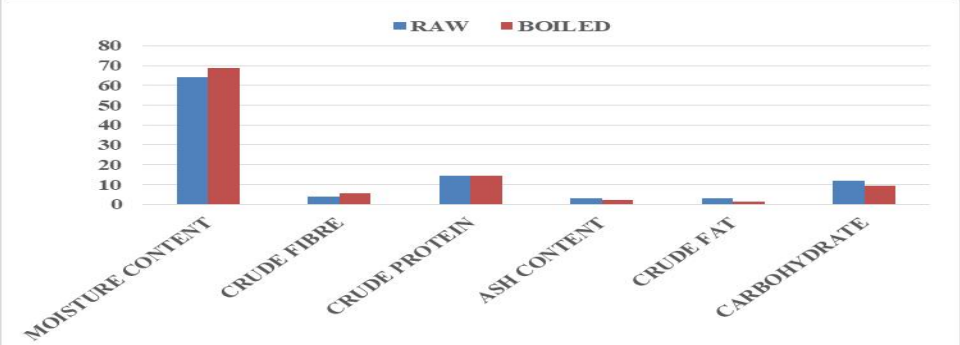

Figure 3: Comparison of the Proximate Composition of Raw and Boiled Samples of *B. aethiopum* Seed Shoots

Six parameters were screened for their proximal compositions. There are significant difference_in the moisture, crude fibre, ash, crude fat and carbohydrate contents of the raw and boiled samples. The boiled samples increased in moisture and fibre contents while the ash, crude fat and carbohydrate contents decreased upon boiling. Even though there was no significant difference (P> 0.05) in the protein contents of the raw and boiled samples, it decreased slightly on boiling. This is in agreement with the results obtained by Zango *et al*, (2019), who carried out a similar study on the same species. However, the Carbohydrate contents of both the raw and boiled samples obtained by Zongo *et al*. (2019) are much higher than what was obtained in the present study. The reduced carbohydrate value after boiling in the present study indicates that boiling helps to reduce the starch level in Palmyra. The boiled seed shoot may thus be safer for the diabetic consumers (Figure 3).

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This result differ from that of Nakkeeran and Shankar (2017) where the carbohydrate content increased with boiling while working on *Borassus flabellifer* L.

The protein content of the sample of *B. aethiopum* obtained in this study although higher than that obtained by Zongo *et al.* (2019) for both the raw and boiled samples, the results showed decrease in the protein content. Nakkeeran and Shankar, (2017) showed increase in the protein contents on boiling. Although the raw and the boiled are good sources of protein, the relatively high crude protein may be attributed to the absorption potentials of essential nutrients from the soil by the plant (Figure 3).

The moisture and crude fibre contents of *B. aethiopum* in this study were higher in the boiled sample (Figure 3). It can safely be concluded that boiling enhanced the moisture and fibre contents of *B. aethiopum* because it is basically a hydrolytic process. On the other hand, the values of Crude protein, Ash content, crude fat and carbohydrate reduced in the boiled samples. Reduction in protein content may be due the effect of heat on the samples as protein may be denatured by excessive heating. Crude fat greatly reduced on boiling (Figure 3). While Nakkeeran and Shankar, (2017) showed increase in the fibre content of boiled samples, there was a decrease in the moisture content of their samples after boiling. The values of the crude fibre, crude fat, ash and mineral contents obtained in this study were lower than those reported by Akinniyi *et al.* (2000). These differences may be due to variations in the geographical locations of their growth, their stage of maturity, and the extent of boiling. Increase in the crude fibre content of the boiled sample is important in facilitating effective digestion in the human body. Fibre directly clears up indigestion, constipation, diarrhea, and generally tones up the digestive system for regular, healthy bowel movements. Crude fat content of *B. aethiopium* in this study had reduced on boiling. This is opposed to the result of Zongo *et al.* (2019). The lipid content increased with boiling in the work of Nakkeeran and Shankar (2017). The values of the crude fat in this study is higher than that obtained by Zongo *et al.* (2019) and Nakkeeran and Shankar (2017).

The ash content reduced on boiling. This result agrees with Zongo *et al.* (2019) but the result in this study showed higher ash content. This may be as a result of conversion of elements into compounds. The observed range of ash content indicates that the species are good source of minerals such as Potassium, Zinc and Magnesium. It also shows that *B. aethiopium* is rich in fluorine and iodine. The boiled sample is rich in iron more than the raw. Iron binds with haemoglobin in the transport of oxygen suggesting higher efficiency of aerobic respiration (Megan Ware., 2014).

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Phytochemical Properties

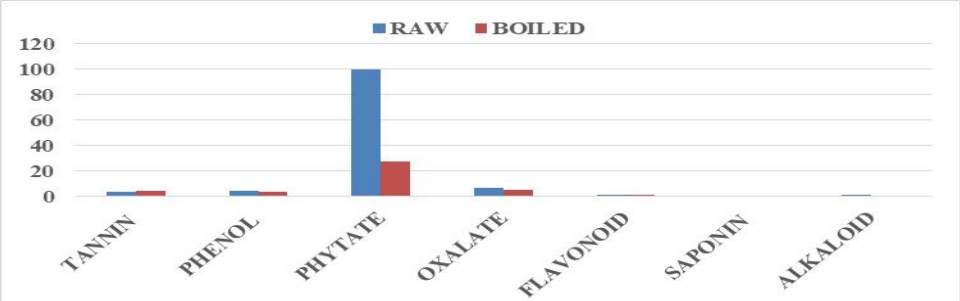

Figure 4: Comparison of the Phytochemical Composition of Raw and Boiled *B. aethiopum* Seed Shoots

Phytochemicals are secondary metabolites in plants that perform various functions in the overall wellbeing of the plants. They also perform very useful functions in man when consumed. Man, in his various attempts to remediate myriads of diseased conditions has synthesized several metabolites. In this study, Tannin, Phenol, Phytate, Oxalate, Flavonoid, Saponin and Alkaloid were identified.

There is no significant difference (P> 0.05) in the Tannin and phenolic compounds when Tannin increased slightly and phenol decreased slightly. There is significant difference between the phytate, oxalate, flavonoid, saponin and alkaloid contents of the raw and boiled samples. Flavonoid content increased while phytate, Oxalate, Saponin and Alkaloid decreased. The potential benefits of phytic acid is said to occur in instances of high dietary phytic acid intake. However, a high intake has also been associated with reduced mineral absorption.

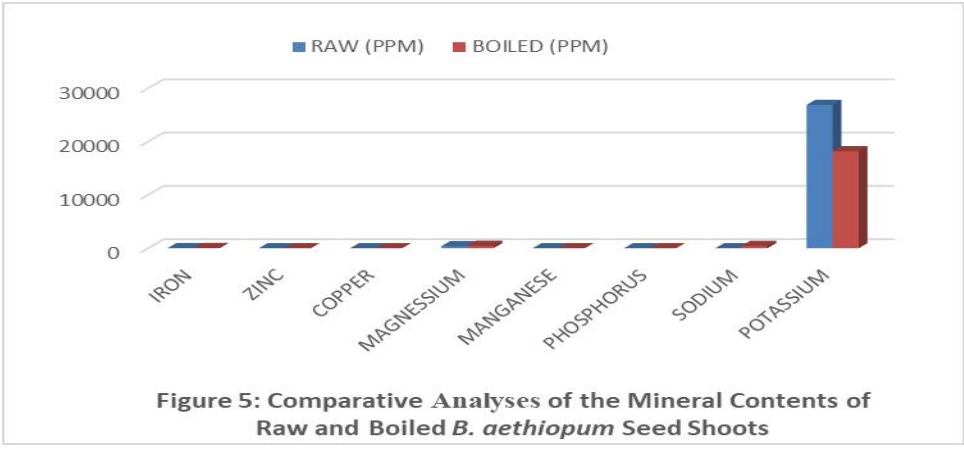

Figure 5: Comparative Analyses of the Mineral Contents of Raw and Boiled *B. aethiopum* Seed Shoots

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Schlemmer *et al.* (2009) suggested that minimizing the negative effects while maximizing the beneficial effects is by incorporating more vitamin C (ascorbic acid) into diet, specifically with regards to iron. The result of this study showed that phytate value reduced after boiling while the other binding minerals increased (Table 3), due to its binding effect with certain dietary minerals including iron, zinc, manganese and, to a lesser extent calcium. The reduction in Phytate content makes the consumption of boiled *B. aethiopum* safer.

Saponins are classified into Groups A and B. Group A are acetylated saponins present in soybean mostly responsible for undesirable bitter and astringent taste, whereas Group B saponins possess several health benefits. Recent in vitro studies have established that the health benefits such as hypocholesterolemic (cholesterol lowering) effect, anti- carcinogenic, anti-oxidative, anti-tumor, anti- virus, anti-hepatic, anti-diabetic and hepato- protective properties of food legumes are due to presence of group B saponins (Rajendra., 2014). Boiling reduced saponin value in this study, indicating why the bitter taste of the raw sample reduced to almost tastelessness on boiling.

Flavonoids are natural products, well known for their beneficial effects on health as anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties coupled with their capacity to modulate key cellular enzyme function and broad spectrum of biological activity (Panche *et al.*, 2016, Ruiz-Cruz*et et al.*, 2011). Boiling increased the Flavonoid content appreciably. Onguene *at al.* (2013) has also asserted that alkaloids, terpenoids, flavonoids, coumarines, and phenolics are mainly for malaria treatment.

Mineral/Element Contents

Parameters of the ash content analyzed were Iron, Zinc, Copper, Magnesium, Manganese, Sodium and Potassium (Figure 5). The observed range of ash content indicates that *B. aethiopum*is a good source of minerals such as Iron, Potassium, Zinc and Magnesium. There were significant differences in the quantity of all the elements identified. The quantities of Zinc, Copper and Potassium decreased with boiling while Iron, Magnesium, Manganese, Phosphorus and Sodium increased in the boiled samples (Table 3). The boiled were richer in iron than the raw, making it better for health since iron binds with haemoglobin in the transport of oxygen (Megan Ware., 2014).

After the age of 14, the Recommended Daily Allowance (RDA) for men ranges from 400-420 milligrams. For women 14 years and older, the RDA ranges from 320-360 milligrams. In this study, the magnesium value increased after boiling that is; it is better eaten boiled than raw to meet the daily required quantity (WHO, 2014). Recent discovery has linked phosphorous to heart health, meaning that with adequate intake, humans can better protect themselves from a range of cardiovascular diseases, (Murray *et al.*, 2000). Sodium preserves normal irritability of cells and muscles permeability and helps in the maintenance of osmotic pressure of the body fluid. It is therefore better eaten boiled than raw, since boiling increases the Sodium content (Murray *et al.*, 2000). 'An increase in potassium intake along with a decrease in

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sodium and vice versa is the most important dietary change a person can make to reduce their risk of cardiovascular disease', (WHO., 2012). The result obtained in this study correlates with the above statement because after boiling sodium increased while potassium reduced.

CONCLUSION

This study has revealed vividly the differences in proximate composition, phytochemical screening and mineral elements composition of the seed shoots of *B. aethiopum*.It indicated that boiling reduced the carbohydrate, fat and ash content which makes it healthier to consume. Also boiling increases all the available mineral contents except zinc and Potassium. The phytochemical constituents have reduced except tannin and flavonoid upon boiling.

Consumption of boiled *B. aethiopum* is better compared to the raw one because it has greater advantages for health as revealed in the present study.

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