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Functional and Nutritional Properties of Kenaf Seed

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Abstract

This study investigated the functional and nutritional properties of Kenaf seed. Kenaf seed powder was subjected to nutritional and biochemical analyses. The results showed that Kenaf seed contained 24.93% crude protein, 18.94% fat, 13.45% fibre, 4.5% ash, 5.01% moisture and 33.1% carbohydrate. Kenaf seed recorded appreciable level of Na, Ca, Mg, P, and Fe. The kenaf seed extract had appreciable reducing potential. Kenaf seed contained 1.3% flavonoid and 381mg GAE/g total phenol. The observations of this study present Kenaf seed as a source of antioxidants. Therefore, agro wastes such as Kenaf seed can be harnessed into valuable products.

Keywords: *Kenaf Seed; Mineral Element; Nutritional Quality*

Introduction

The increasing demand for nutraceuticals had called for the search for new sources of these compounds. Several scientific studied had pointed at the consistent rich sources of antioxidants among edible fruits, but little or few literature highlighted on waste parts of fruits such as the seeds and peels. Fruits and vegetables wastes are formed in large amounts daily either during farm gate or industrial processing. These portend serious threat to the environment. There is dire need to manage and utilize them. Aleksandra and Tomasz [1] reported on the efforts been made to improve methods of re-using fruits and vegetables wastes for the purpose of valorisation of the antioxidants and other bio-components in by-products. Thousands of seeds like kenaf seed are being wasted on regular basis without recourse to its functional values.

Kenaf (*Hibiscus cannabinus*) is a warm-season annual herbaceous plant that has great potential as a source of fiber, energy, and feedstock. Kenaf seeds have different potentials for various domestic and industrial uses. Kenaf seed is a by-product of the kenaf industry. Hitherto, non-viable Kenaf seeds are always been discarded except if it is been used for animal feed. Studies have suggested that kenaf seed oil (23.7%) is suitable for human consumption due to its unique fatty acid composition and antioxidant activity. It can be processed into cosmetic oil, cooking oil, bio-diesel and industrial lubricants. Oil produced by the kenaf plant is used for first-class cooking oil and margarine production [2]. Kenaf seed is regarded as non-edible seed to humans but use for livestock feeds. Despite high nutrient values of kenaf seed, many are yet to tap the potentials and maximize its utilization in several countries of the world.

The oxidative reactions proceeding in foods are the main cause of its deterioration. They are responsible for the nutritional value losses, as well as aroma, taste and texture degradation. For this reason, natural antioxidants such as phenolic compounds and other phytochemicals have emerged as safer alternatives to synthetic antioxidants in recent years. According to Miraliakbari and Shahidi [3], natural antioxidants can function as free radical scavengers, reducing agents, chelators of pro-oxidant metals, or as quenchers of singlet oxygen and thus delay the lipid oxidation process in food products. Synthetic antioxidants such as Butylated hydroxyl anisole (BHA) and

Butylated hydroxyl toluene (BHT) have been being commonly used during food processing in order to prolong the storage stability of fats, oils and lipid-containing foods, but these synthetic antioxidants have caused a number of physiological disorders and diseases [4,5]. Antioxidants are compounds which may inhibit or decrease the rate of oxidation of other molecules by preventing the initiation or propagation of the chain reaction of free radicals.Natural antioxidants such as phenolic compounds and other phytochemicals have emerged as safer alternatives to synthetic antioxidants in recent years [6]. The antioxidant sources based on this origin have not been explored so far. Hence, there is need for the newer sources which may be safer, more economical and preferably from dietary sources. The objectives of this study were to determine the antioxidant properties and nutritional composition of Kenaf seed.

Methodology

Collection of Sample: Kenaf seed was obtained from the Kenaf and Jute Improvement Programme, Institute of Agricultural Research and Training (I.A.R. &T), Ibadan. Nigeria.

Proximate composition: Kenaf seed was ground to powder and subsequently analyzed chemically according to the Official methods of analysis [7]. All analyses were carried out in triplicate.

Crude Protein

The crude protein in the kenaf seed were determined by the routine semi-kjeldahl, procedure/technique.
The crude protein content is determined by multiplying percentage Nitrogen by a constant factor of 6.25
I.e. % Crude protein = % N × 6.25 [7].

Crude Fat Determination

1gm of each dried samples of kenaf seed was weighed into fat free extraction thimble and pug lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser and a 250 ml soxhlet flask which has been previously dried in the oven, cooled in the desiccator and weighed. The soxhlet flask is then filled to ¾ of its volume with petroleum ether (b.pt 40° - 60°C), and the soxhlet flask. Extractor plus condenser set was placed on the heater. The heater was put on for six hours with constant running water from the tap for condensation of ether vapour. The set is constantly watched for ether leaks and the heat source is adjusted appropriately for the ether to boil gently. The Ether is left to siphon over at least 10 - 12 times until it is short of siphoning. It is after this is noticed that any ether content of the extractor is carefully drained into the ether stock bottle. The thimble containing sample of Kenaf seed is then removed and dried on a clock glass on the bench top. The extractor, flask and condenser is replaced and the distillation continues until the flask is practically dry. The flask which now contains the fat or oil is detached, its exterior cleaned and dried to a constant weight in the oven. If the initial weight of dry soxhlet flask is W_0 and the final weight of oven dried flask + oil/fat is W_1, percentage fat/oil is obtained by the formula:

$$\% \ Crude\ fat = \frac{W_1 - W_0 \times 100}{Wt\ of\ kenaf\ seed} \quad (1)$$

Dry Matter and Moisture Determination

2g of the digested kenaf seed was weighed into a previously weighed crucible. The crucible plus kenaf taken was then transferred into the oven set at 100°C to dry to a constant weight for 24 hours overnight. At the end of the 24 hours, the crucible plus kenaf was removed from the oven and transferred to desiccator, cooled for ten minutes and weighed. If the weight of empty crucible is W_0, Weight of crucible plus kenaf is W1, Weight of crucible plus oven dried kenaf seed W_3

$$\% \ D.M = \frac{W_1 - W_3 \times 100}{W_1 - W_0 \times 1} \quad (2)$$

$$\% \text{ Moisture} = 100 - \% \text{ D.M} \quad (3)$$

Fibre Determination

Two grams of kenaf seed was accurately into the fibre flask and 100 ml of 0.255N H_2SO_4 added. The mixture was heated under reflux for 1 hour with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filterate obtained was thrown off and the residue was returned to the fibre flask to which 100 ml of (0.313N NaOH) was added and heated under reflux for another 1 hour. The mixture was filtered through a fibre sieve cloth and 10 ml of acetone added to dissolve any organic constituent. The residue was washed with about 50 ml hot water on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue were oven – dried at 105°C overnight to drive off moisture. The oven – dried crucible containing the residue was cooled in a desiccator and later weighed to obtain the weight W1. The crucible with weight W1 was transferred to the muffle furnace for Ashing at 550°C for 4 hours.

The crucible containing white or grey ash (free of carbonaceous material) was cooled in the desiccator and weighed to obtain W_2. The difference $W_1 – W_2$ gives the weight of fibre. The percentage Fibre was obtained by using the formula:

$$\% \ Crude\ fibre = \frac{W_1 - W_2 \times 100}{Wt.of\ kenaf\ seed \times 1} \quad (4)$$

Determination of Ash

2.0g of kenaf seed were weighed into a proclaim crucible. This was transferred into the muffle furnace set at 550°C and left for about 4 hours. About this time it had turned to white ash. The crucible and its content were cooled to about 100°C in air then room temperature in a desiccator and weighed. The percentage ash was calculated from the formula below:

$$Ash\ content = \frac{Wt\ of\ ash \times 100}{Wt\ kenaf\ seed\ sample \times 1} \quad (5)$$

Reducing Potential

The reducing potential of kenaf seed extract was measured according to the method of Wu., *et al*. [8] with some modifications. Briefly, freeze dried samples at concentrations of 0.5, 1.0 and 1.5 mg/ml were dissolved in a 0.2 M phosphate buffer (pH 6.6). An aliquot (2.5 mL) of Kenaf seed solution was then added to 2.5 mL of 1% (w/v) potassium ferricyanide. The mixture was incubated at 50°C for 20 minutes, followed by addition of 2.5 mL of 10% (w/v) Trichloroacetic Acid (TCA). After incubation 2.5 mL of distilled water and 2.5 mL of 0.1% (w/v) $FeCl_3$ were added to the mixture. The absorbance of the solution was then recorded immediately at 700 nm. The blank of each sample was prepared by adding distilled water instead of $FeCl_3$. Net increase in absorbance of the reaction mixture indicates increased reducing power.

Flavonoids Determination

0.50g of finely ground kenaf seed was weighed into a 100 ml beaker and 80 ml of 95% Ethanol added and stirred with a glass rod to prevent lumping. The mixture was filtered through a Whatman No.1. Filter into a 100 ml volumetric flask and made up to mark with Ethanol. 1 ml of the extract was pipetted into 50 ml volumetric flask, four drops of conc. HCl added via a dropping pipette after which 0.5g of magnesium turnings added to develop a magenta red coloration. Standard flavonoid solution of range 0 - 5 ppm were prepared from 100 ppm stock solution and treated in a similar way with HCl and magnesium turnings like kenaf seed. The absorbance of magenta red coloration of kenaf seed and standard solutions were read on a digital Jenway V6300 Spectrophotometer at a wavelength of 520 nm [5]. The percentage flavonoid is calculated using the formula.

$$\% \ Flavonoid = \frac{Absorbance\ of\ kenaf\ seed\ extract \times average\ gradient\ factor \times dilution\ factor}{Wt\ of\ kenaf\ seed \times 100} \quad (6)$$

Total Phenolic contents

The total phenolic compound contents were determined by Folin-Ciocalteu reagent [9]. 0.5g of kenaf seed was weighed into a 250 ml flask, 25 ml of 80% methanol was added and homogenize to form a uniform solution and filtered through a Whatman No 42 Filter paper.

3 ml of the above filterate was pipette into a 30 ml test tube, 1 ml mixture of Folin-Ciocalteu reagent was added and mixed thoroughly, 3 milliliters of Na_2CO_3 (2%) was added to the mixture and homogenize. Standard solution of gallic acid was used and absorbance of both the working standard as well as Kenaf seed extract were read using on a Cecil 2483 Spectrophotometer at a wavelength of 760 nm. The amount of total phenol was calculated as a gallic acid equivalent (GAE) in mg per g of dry mass.

Statistical analysis

Data obtained were analysed using a single factor Analysis of Variance test (ANOVA) and means separation were performed with a Tukey's multiple comparison tests. Differences were considered significant at $p < 0.05$.

Results and Discussion

The results in figure 1 showed that Kenaf seed contained 24.93% crude protein, 18.94% crude fat, 13.45% crude fibre, 4.5% ash, 5.01% moisture and 33.1% carbohydrate and these values were slightly lower than the reported proximate content of roselle seed powder by Abdoulaye [10]. However, Kenaf and Roselle (*Hibiscus sabdariffa*) seeds being a member of the same family, *Malvacaea* were not significantly different in terms of their ash content. From this results, Kenaf seed is considered as a good source protein and should be used either as a food for man (in the form noodles) or animal feeds. The high fibre content of Kenaf seed will help to maintain the health of the gastrointestinal tract and can be used in weight regulation [11] but in excess it may bind trace elements, leading to deficiency of some of the micro nutrients in the body like iron and zinc [12]. High fibre content will make Kenaf seed ideal food that could be harnessed in the control of cholesterol absorption hence protect against coronary heart disease risks. This result strongly supports the report by Siddhurju., *et al.* [12] that high fibre content in fruits could be harnessed in the control of blood glucose levels in normal and diabetic individuals thereby protecting man against excessive weight gain and obesity and its associated diseases

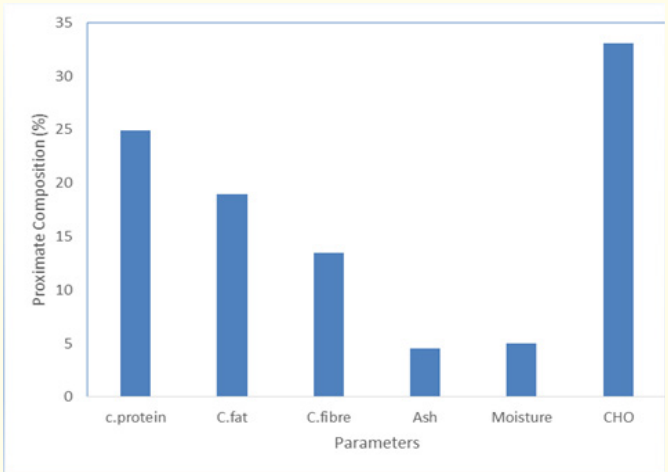

Figure 1: *Proximate composition (%) of Kenaf seed.*

Parameter	This study (Kenaf seed)	Literature for Roselle seed Abdoulaye (2003)
% Na	0.022 ± 0.01	0.043 ± 2.83
% K	0.386 ± 0.02	1.98 ± 0.58
% Mg	0.181 ± 0.00	0.411 ± 0.76
% Ca	0.263 ± 0.01	0.216 ± 0.55
% P	0.160 ± 0.01	-ND
Fe(mg/kg)	211.7 ± 0.2	80.17 ± 0.49

Table 1: *Comparative mineral content of H. cannabinus and H. sabdariffa seeds.*

Values are means ± SD; ND: Not Detected

The results in table 1 showed mineral composition of Kenaf seed in comparative to that of Roselle seed. This study has slightly lower level of sodium, potassium and magnesium than those found in Roselle seed. Conversely, Kenaf seed had significantly higher calcium and iron content than the reported data for Roselle seed by Abdoulaye [10]. Pertinently, these seeds can contribute in a moderate quantity to the amount of sodium needed in the body since recommended daily allowance (RDA) value for sodium for an adult is 500 mg [13]. On the other side, high sodium content makes them not to be ideal food material for prevention and management of hypertension mineral elements such as Fe, Co, Cu, Mn, Mo and Zn are called heavy metals and required by our bodies in varying amounts. However, in higher levels they are toxic and can be damaging to the organism. Other heavy metals such as Pb, Hg and U have no known vital or beneficial effect in living organisms' bodies and their accumulation over time in our bodies can cause serious adverse health effect [14]. Although, many of these heavy metals were not detected in kenaf seed and it follows therefore that Kenaf seed may not be deleterious when consumed by man or animals.

Results presented in figure 2 revealed that the presence of antioxidants in Kenaf seed extract caused the reduction of the Fe^{3+}/ferricyanide complex to the ferrous form and the yellow color of the test solution changed to blue color. The absorbance of aqueous Kenaf seed extract at different concentrations were 0.043, 0.061, and 0.075. The reducing power of Kenaf seed extract increased with increase in amount of sample concentration (0.5, 1, 1.5 mg/mL). This result indicated that Kenaf seed extracts are capable of donating electrons, which can react with free radicals to convert them to stable products and thereby strongly inhibit radical chain reaction.

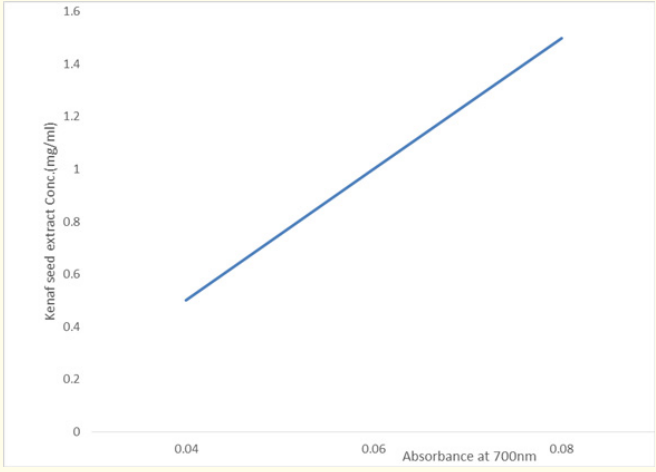

Figure 2: *Reducing power of Kenaf seed extract at different concentration.*

The antioxidative properties of Kenaf seeds are further displayed by the flavonoid and total phenolic content in table 2. The data obtained from this study was in agreement with Aleksandra and Tomasz [1] that fruit seeds and peels used as agro- waste products are rich source of antioxidants. Kenaf seed contained slightly lower total phenol compared to other seeds and peel of fruits reported by Aleksandra and Tomasz [1]. Also, the findings of this study supported pertinent literatures which stated that the free-radical-scavenging potential of natural polyphenols depend on the number and arrangement of free –OH groups on the flavonoid skeleton [15]. Kenaf seed derived-flavonoids can lose a hydrogen-reducing metal rendering them less pro-oxidative [16,17].

% Flavonoid	1.3 ± 0.01
Total Phenol (mg GAE/g)	381 ± 0.10

Table 2: *Antioxidative activities of Kenaf seed.*

Values are means ± standard deviations of triplicate determinations, GAE: Gallic Acid Equivalent

Conclusion

The results of this present study revealed that Kenaf seed is rich in functional food nutrients and is also a cheap potential source of antioxidant like polyphenols and flavonoids. Agro wastes such as Kenaf seed can be harnessed into valuable products.

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Bibliography

1. Aleksandra DC and Tomasz T. "Antioxidant properties of different fruit Seeds and peels". *Acta Scientiarum Polonorum Technologia Alimentaria* 6.3 (2007): 29-36.

2. Karpinska M., *et al*. "The use of natural antioxidants in ready-to-serve food". *Food Chemistry* 72.1 (2001): 5-9.

3. Miraliakbari H and Shahidi F. "Antioxidant activity of minor components of tree nut oils". *Food Chemistry* 111.2 (2008): 421-427.

4. Omenna EC. "Antioxidant properties of the different extracts from Almond plant (T. catappa)". LAP Lambert Academic Publishing. Germany (2016): 20-35.

5. Iqbal S., *et al*. "Antioxidant properties and components of bran extracts from selected wheat varieties commercially available in Pakistan". *LWT - Food Science and Technology* 40.2 (2007): 361-367.

6. Borowska J. "Owoce i warzywa jako zródło naturalnych przeciwutleniaczy [Fruits and vegetables as source of natural antioxidants]". *Przemysł Fermentacyjny i Owocowo-Warzywny* 47.5 (2003): 11-12.

7. AOAC International Official standard methods of analysis. Association of Official analytical Chemists. Washington DC (2005).

8. Wu HC., *et al*. "Free amino acids and peptides as related to antioxidant properties in protein hydrolysates of mackerel (Scomber austriasicus)". *Food Research Internationa*l 36.9-10 (2003): 949-957.

9. Singleton VL and Rossi JA Jr. "Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents". *American Journal of Enology and Viticulture* 16 (1965): 144-158.

10. Abdoulaye. "Nutritional composition of roselle seed". Journal of Food Chemistry (2013): 203-210.

11. Howarth NC., *et al*. "Dietary fiber and weight regulation. Energy density of foods affects energy intake across multiple levels of fat content in lean and obese women". *American Journal of Clinical Nutrition* 73 (2001): 1010-1018.

12. Siddhurju P., *et al*. "Fibres in fruits". *Journal of Food Chemistry* 3 (1996): 385-389.

13. National Research Council, N.RC., USA recommended Dietary Allowances Washington, DC, National Academy press (1998): 42.

14. Esther HL., *et al*. "Postharvest Changes in physicochemical Properties and Levels of some inorganic elements in sugar Apple (Annona squamosa L.) Fruits of Coast Region, Tanzania". *Journal of Food and Nutrition Sciences* 4.3 (2016): 41-48.

15. Kondo S., *et al*. "Anti-oxidative activity of apple skin or flesh extracts associated with fruit development on selected apple cultivars". *Scientia Horticulturae* 96.1-4 (2002): 177-185.

16. Chan KW., *et al*. "Preparation of clove buds deodorized aqueous extract (CDAE) and evaluation of its potential to improve oxidative stability of chicken meatballs in comparison to synthetic and natural food antioxidants". *Journal of Food Quality* 35.3 (2012): 190-199.

17. Noordin MY., *et al*. "Phenolic Content and Antioxidant Activity of Hibiscus cannabinus L. Seed Extracts after Sequential Solvent Extraction". *Molecules* 17.11 (2012): 12612-12621.

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