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Research Article
Assessment of Some Nutrients in the Roasted Seeds of Negro Coffee (*Cassia occidentalis*)

[1]S.O. Arekemase, [2]J.A. Adudu, [2]I. Abdulwaliyu, [2]M.L. Batari, [2]O. Aribido, [2]M.H. Mahmud and [3]O.O. Owolabi

[1]Department of Petrochemical and Allied, National Research Institute for Chemical Technology, Zaria, Nigeria
[2]Department of Scientific and Industrial Research, National Research Institute for Chemical Technology, Zaria, Nigeria
[3]Bioresources Development Centre, National Biotechnology Development Agency, Lugbe, Abuja, Nigeria

Abstract

Background and Objective: The pressing need for affordable foods has led to the exploitation of many underutilized plants. *Cassia occidentalis* is widely distributed in nature and are sometimes used as a substitute for coffee. Despite being used in roasted form "as coffee", nutrients in the roasted seeds of this plant has not been largely explored. In this study, the objective was to evaluate some nutrients in the roasted seeds and the roasted seeds oil of this plant. **Materials and Methods:** About 100 g of the well dried seeds of *Cassia occidentalis* was subjected to heat (roasted) for 5 h using a Vulcan air oven at 150°C and then crushed to obtain a powdered sample. Thereafter, the minerals, vitamins, amino acids and fatty acids profile of the roasted seeds were determined using standard protocols. **Results:** Result obtained from the amino acid analysis showed that the roasted seeds of this plant contained essential amino acids (except tryptophan, which was not detected). The roasted seeds also revealed appreciable amount of minerals and vitamins. The fatty acid profile revealed reasonable percentages of 9-octadecenoic acid (oleic acid) (33.19%) and 9, 12-Octadecadienoic acid (linoleic acid) (21.22%), while tetra decanoic acid (myristic acid) (2.68%) ranked the lowest. **Conclusion:** The high nutrients content in the roasted seeds and the roasted seeds oil of this plant confirm it to have good nutritional value.

Key words: *Cassia occidentalis*, roasted seed, mineral, vitamin, amino acid, fatty acid

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Corresponding Author: S.O. Arekemase, Department of Petrochemical and Allied, National Research Institute for Chemical Technology, Zaria, Nigeria

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Daily quest for affordable foods, medications and beverages has led to the discovery of many underutilize plants rich in phytonutrients and biologically active metabolites. As a result, few plants are now in use as tea, an aromatic beverage, commonly consumed in different parts of the world. Tea consumption may contribute to healthy living as it contains numerous bio-active compounds. However, many are a poor source of phytonutrients and the presence of caffeine in tea has shown to impair health integrity[1], thus suggesting the need to shift to the use of plants containing no or low caffeine and also rich in phytonutrients.

Cassia occidentalis contains apparently no caffeine, although it was recently revealed to contain trace amount (0.005 mg/100 g) of caffeine[2]. It has a long history of being use as tea beverage, hence the name "coffee senna or negro coffee" But the ill knowledge of its nutritional and medicinal importance has hampered its full utilization. The plant is also poorly utilized owing to its toxic attribute. For this reason, animals usually avoid the ingestion of the seed[3]. Ingestion of large amount of the seed has been reported to cause toxicity problems and even death in animals[4]. Study also revealed the correlation between *Cassia occidentalis* poisoning and hepatomyoencephalopathy in young children in western Uttar Pradesh (UP)[5]. It has been observed that addition of raw seeds of this plant, at a dose of 0-100 g kg^{-1}/day for 20 days manifested clinical signs such as body weight loss, increase of serum ammonia and hepatosomatic index[6]. Other clinical signs associated with toxicity of *Cassia occidentalis* includes, ataxia, muscle weakness, stubbing and eventually leading to death[7]. The seed being the most toxic part of the plant[8] has shown to have medicinal values. To mention few, the plant extracts possesses anti-malarial, anti-fungal, anti-bacterial, anti-inflammatory and hepatoprotective efficacies[9]. For this reason, few poly-herbal formulations now contain *Cassia occidentalis*[10,11]. Aside the medicinal importance of *Cassia occidentalis*, its nutritional value has also been studied and has been proposed to be transformed into a high quality animal feed[12].

Cassia occidentalis is a pantropical plant species, belonging to the family Leguminosae and the sub family Caesalpiniaceae[13]. The plant is rich in secondary metabolites, particularly phenolics as exemplified by flavonoids and anthraquinone[14]. Most of these metabolites are responsible for the ethnomedicinal values of this plant and their safety must be addressed[15]. The chemical constituent of this plant varies with plant parts. The plant root contains emodin, while the seeds contain chrysarobin and N-methylmorphine[16].

Cassia occidentalis has been reported to be poisonous[17]. Despite claims of being poisonous, the seeds are still in use in roasted form as a substitute for coffee with little nutritional information. As such, the researchers sought to evaluate the nutrient contents in the roasted seeds and the roasted seeds oil of this plant.

MATERIALS AND METHODS

Plant collection and authentication: The seeds of this plant were obtained from the field of National Research Institute for Chemical Technology (NARICT), Basawa, Zaria, Kaduna state, Nigeria. The seeds were authenticated as seeds of coffee senna (*Cassia occidentalis*) at the Department of Biological Sciences, Ahmadu Bello University, Zaria, Kaduna state, Nigeria.

Seeds preparation: The seeds collected were thoroughly dried at room temperature for 4 days. One hundred grams of the well dried sample was subjected to heat (roasted) for 5 h using a Vulcan air oven at 150°C crushed to powdered sample having the characteristics like, "coffee".

Mineral determination: The elemental constituents in the roasted seeds of *Cassia occidentalis* were determined using a Shimadzu Atomic Absorption Spectrophotometer (AAS 6800) Shimadzu. Prior to this analysis, 1 g of the sample was digested following the procedure described by Abdulwaliyu *et al.*[18].

Amino acid determination: The amino acid profile in the roasted seeds powder was determined using an amino acid analyzer, Technicon TSM-1, (Model: DNA. 0209). The sample was prepared following the procedure described by Dakare *et al.*[19].

Vitamin determination: The vitamin content in the roasted seed of this plant was evaluated using a Shimadzu 2550 UV-Vis Spectrophotometer. The sample was prepared following the procedure described by Ashok and Kumar[20] for fat soluble vitamins and Khan *et al.*[21] for water soluble vitamins.

Oil extraction: The oil was extracted from the powdered roasted seeds of *Cassia occidentalis* using n-hexane in a soxhlet system, a modification of the AOAC Official Method[22] 945.16.

Fatty acid determination: The fatty acid composition of the seeds oil was determined using a Shimadzu Gas

Table 1: Amino acid contents (g/100 g) in the roasted seeds of negro coffee (*Cassia occidentalis*)

Amino acid	Composition (g/100 g)
Lysine	3.46
Histidine	2.08
Arginine	4.83
Aspartic acid	8.43
Threonine	2.59
Serine	3.01
Glutamic acid	9.69
Proline	2.44
Glycine	3.43
Alanine	4.18
Cysteine	0.86
Valine	3.79
Methionine	1.09
Isoleucine	2.66
Leucine	7.24
Tyrosine	2.70
Phenylalanine	3.88

Chromatography-Mass Spectrophotometer (GC-MS). Prior to the analysis, the oil was methylated following the procedure described by Arekemase *et al*.[23].

Statistical analysis: In vitamin and mineral analysis, data obtained was subjected to one way analysis of variance (ANOVA) using SPSS version 20.0 and the data are expressed as mean±standard deviation.

RESULTS

Observation in the mineral analysis revealed that the roasted seeds of *Cassia occidentalis* contained the following mineral composition: Ca (108.37±0.52 mg/100 g), Cu (1.05±0.21 mg/100 g), Fe (35.86±0.11 mg/100 g), Na (49.52±0.89 mg/100 g), Mg (18.34±0.41 mg/100 g), Zn (6.48±0.19 mg/100 g) and K (102.38±0.22 mg/100 g).

Observation in the vitamin analysis as shown in Fig. 2 revealed that the roasted seeds of *Cassia occidentalis* revealed ample amount of β-carotene (45.57±1.32 IU) and Vitamin E (59.13±1.22 IU). Our findings also showed that the roasted seeds of this plant contained Vitamin C (8.09±0.27 mg mL^{-1}), Vitamin B_1 (13.02±0.19 mg mL^{-1}), Vitamin B_2 (12.08±0.44 mg mL^{-1}) and Vitamin B_6 (16.06±0.72 mg mL^{-1}) (Fig. 2).

Result in Table 1 showed the percentage amino acids composition in the roasted seeds of *Cassia occidentalis*. Our findings revealed that cysteine ranked the least in composition (0.86 g/100 g) among the amino acids revealed in this study.

Figure 3 revealed the fatty acid (%) composition in the roasted seeds of *Cassia occidentalis*. The roasted

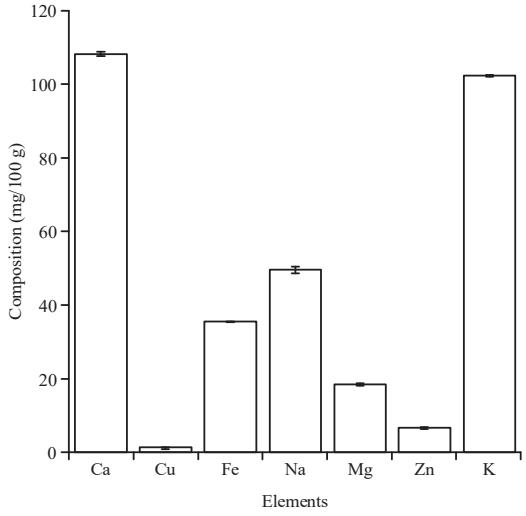

Fig. 1: Minerals contents (mg/100 g) in the roasted seeds of *Cassia occidentalis*
Ca: Calcium, cu: Copper, Fe: Iron, Na: Sodium, K: Potassium, Zn: Zinc, Mg: Magnesium

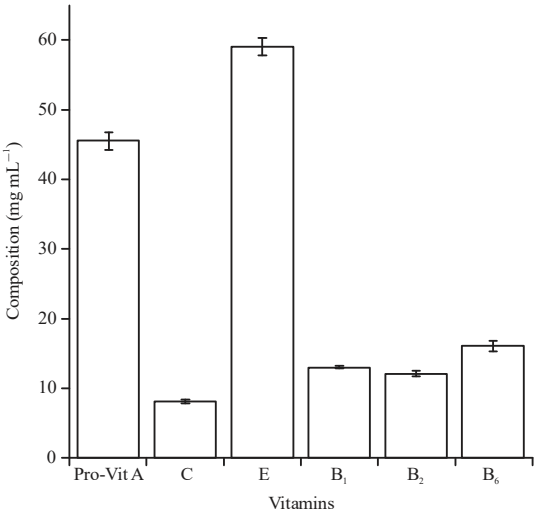

Fig. 2: Vitamin profile of *Cassia occidentalis*
Pro-Vit A: Provitamin A, C: Vitamin C, E: Vitamin E, B_1: Vitamin B_1, B_2: Vitamin B_2, B_6: Vitamin B_6. N:B vitamin E and provitamin A are expressed in international unit (IU)

seeds contained Myristic acid (2.68 g/100 g), Caprylic acid (5.09 g/100 g), Palmitic acid (18.61 g/100 g), Stearic acid (19.21 g/100 g), Linoleic acid (21.22 g/100 g), Oleic acid (33.19 g/100 g). The result revealed more degree of unsaturation than the saturated fatty acid.

DISCUSSION

Nutrients are substances that provide nourishment, essential for the maintenance of the chemistry of life. This can

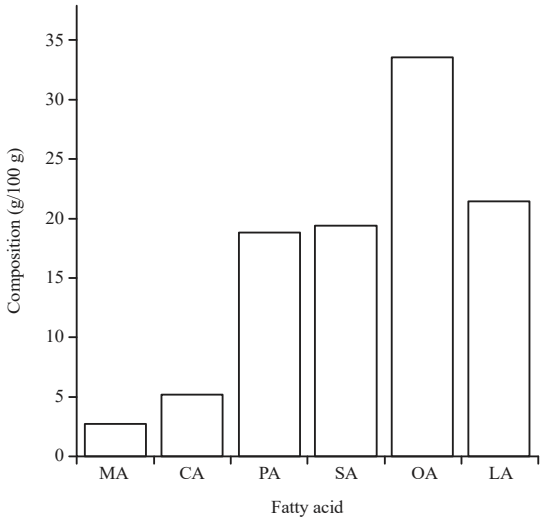

Fig. 3: Fatty acid profile of *Cassia occidentalis*
MA: Myristic acid, CA: Caprylic acid, PA: Palmitic acid, SA: Stearic acid, OA: Oleic acid, LA: Linoleic acid

only be achieved via consumption of high nutrient rich foods. Roasted seeds of *Cassia occidentalis* could in part, provide such basic nutrient requirement for healthy life as its nutrient composition enumerated in this study were reasonably high. For instance, the roasted seed contained appreciable amount of Ca (108.37±0.52 mg/100 g), K (102.38±0.22 mg/100 g), Na (49.52±0.89 mg/100 g), Fe (35.86±0.11 mg/100 g) and Mg (18.34±0.41 mg/100 g) (Fig. 1).

In fact, it contains more Fe (35.86±0.11 mg/10 g) and Mg (18.34±0.41 mg/100 g) than the values (16.44 and 0.81 mg/100 g) previously reported for Fe and Mg contents in the defatted seed flour of *C. occidentalis*[24]. Metabolic role of Mg cannot be over emphasized as more than 300 enzyme catalysed reactions are Mg dependent. Some of the metabolic reactions that depend on Mg are an energy yielding reactions. For instance, Mg is required by all cells, "irrespective of the organism" for efficient glucose metabolism, a metabolic event that does not only result in energy production, required by all cells but also produces other essential metabolites. These metabolites serve as precursors for the synthesis of other metabolite necessary in maintaining healthy life. To cite one, glucose-6-phosphate, which is the product of Mg dependent enzyme (hexokinase) catalysed reaction has more than one metabolic fate. Aside progressing in energy production, it (glucose-6-phosphate) can also be diverted into pentose phosphate pathway (PPP) for the production of reduce nicotinamide adenine dinucleotide phosphate (NADPH) and ribose-5-phosphate. So, the roasted seeds of this plant may in part, contribute in cellular energy production and metabolites that could serve precursor purposes. The Fe composition revealed in this study is quite reasonable to consider roasted seed of this plant, a good source of Fe. Although Fe is important for heme synthesis but its source(s) sometimes determine its metabolic utilization as Fe from plants source are usually poorly absorbed compared to animal sources. This may be due to the presence of some plant secondary metabolite that sometimes exhibits anti-nutritional attributes, depending on the anti-nutrient/mineral molar ratio and also depending on what is often consumed. For example, the vegetarians and the vegans are more likely to be deficient in Fe and other essential minerals, than those that often consume different food varieties, from plants and animal sources, a scenario referred to as "mutual supplement". The roasted seed of this plant is rich in calcium. Infact, it is the most abundant mineral in the roasted seed of this plant as revealed in this study. Calcium is an essential mineral for healthy growth, strengthening of bones and teeth and above all, for body system networking. Many plant based foods are rich source of K and the roasted seed of this plant is not exempted. So, consumption of it (roasted seeds) may help replenish K loss, especially in conditions (vomiting, diarrhoea and even as a result of inadequate K intake) that warrant replenishment of K.

Results obtained from the vitamin analysis of the roasted seeds of this plant as shown in Fig. 2, revealed reasonable amount of vitamin E (59.13±1.22 IU) and β-Carotene (45.57±1.32 IU), both of which possesses immeasurable metabolic importance. Vitamin E is highly effective in preventing lipid peroxidation[25]. It (vitamin E) act in the capacity of anti-oxidant in terminating series of oxidative chain reaction. Just like vitamin E, pro-vitamin A also possesses anti-oxidant properties, although it is (pro-vitamin A) less biologically active than vitamin A but more affordable, especially among the poor.

Substantial contents of Vitamin B_1 (13.02±0.19 mg mL^{-1}), B_2 (12.08±0.44 mg mL^{-1}) and vitamin B_6 (16.06±0.72 mg mL^{-1}) were also revealed in this study (Fig. 2). These vitamins function as co-enzymes in many metabolic processes involving carbohydrate, lipid and amino acid metabolism. For instance, vitamin B_1 (thiamine) function as thiamine pyrophosphate (TPP), one of the co-factors involved in the conversion of pyruvate to acetyl co-A, in the aerobic glycolytic pathway. Vitamin B_2 (riboflavin) also functions as co-factor, i.e., flavin adenine dinucleotide (FAD), involved in several important enzymatic reactions like, the conversion of α-ketoglutarate to succinyl co-A, an energy yielding reaction that is analogous to the conversion of pyruvate to acetyl co-A. This implies that the

consumption of the roasted seeds of this plant could contribute to cellular energy production.

The value (8.09±0.27 mg mL^{-1}) obtained for the vitamin C content in this study was lower than the value (17.63±mg mL^{-1}) reported for the raw seed[26]. However, higher values (13.02±0.19 mg mL^{-1} and 12.08±0.44 mg mL^{-1}) were recorded for the thiamine and riboflavin contents, compared to the values (1.40±0.02 and 0.38± 0.01 mg mL^{-1}) previously reported by Gwarzo *et al*.[26].

The amino acid profile is shown in Table 1. These results showed that the roasted seed of this plant is rich in essential amino acids with leucine having the highest percentage composition. The leucine content (7.24 g/100 g) obtained in this study is higher than the content in the seed of soy beans (2.97 g/100 g), peanuts (1.67 g/100 g), wheat germ (1.57 g/100 g), oat (1.28 g/100 g), yellow corn (0.35 g/100 g), moringa seeds (5.27 g/100 g) and human milk[27]. Leucine is an amino acid of metabolic importance. It has the capacity to stimulate muscle protein synthesis and slow the degradation of muscle tissue, especially by increasing the synthesis of the muscle protein[28].

The values for the non-essential amino acid were also recorded with glutamic acid having the highest percentage (9.69 g/100 g). The result also showed that the roasted seed of this plant is deficient in one essential amino acid (tryptophan) and two non-essential amino acids (glutamine and asparagine). Both can be synthesised endogenously from the glutamate and aspartate, respectively.

The fatty acid composition in the oil extracted from the roasted seeds of this plant is depicted in Fig. 3. The result showed high content of oleic acid (33.19 g/100 g), linoleic acid (21.22 g/100 g), stearic acid (19.21 g/100 g) and palmitic acid (18.61 g/100 g). The oleic acid content observed in this study is higher than the value (22.10±0.40 g/100 g) previously reported by Mariod and Matthaus[29]. Oleic acid, although, a non-essential fatty acids but food(s) containing oleic can reduce the level of bad cholesterol (LDL) and increase the level of good cholesterol (HDL).

CONCLUSION

The high content of minerals, vitamins, amino acid and fatty acids in the roasted seeds and the roasted seeds oil of this plant (*Cassia occidentalis*) confirmed it to be of good nutritional value. However, the toxicological implications of consuming the roasted seed of this plant "as a coffee substitute" warrant further investigation.

SIGNIFICANCE STATEMENT

Plants used in the preparation of tea are a good source of plant secondary metabolites, most of which possesses medicinal attributes. Their (secondary metabolites) presence also elicits anti-nutritional effects, thereby causing more nutrients deficiencies. Production of tea from the roasted seeds of *Cassia occidentalis* may contribute in part to nutrient requirement for healthy living as evident in this study.

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