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Chemical Properties of Indigenous Wild Black Plum (Vitex doniana) Seed

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Abstract: *The present study explores the potential usefulness of wild black plum (Vitex donia) seed from Ebonyi State; by assessment of nutritional and phytochemical attributes of the seed, which is usually discarded after consumption of the fruit pulp. Fat and protein were the major nutrients found in the seed, with values of 36.52% and 27.57% respectively. Fatty acid profile showed that monounsaturated oleic acid (58.54%) and saturated palmitic acid (34.24%) are the predominant fatty acids of the seed oil; while thrionine (7.55%) and methionine (6.22%) constitute the major essential amino acids; and proline (8.64%) and glutamic acid (7.33%), the major non essential amino acids. Total essential amino acid content of 37.17% was recorded, indicating that the seed can be considered a good source of essential amino acids. Ash content was 5.18% and is an indication that the wild seed contains reasonable amounts of minerals. In terms of phytochemicals, appreciable amounts of alkaloids (11.40mg/100g) and flavonoids (3.75mg/100g) were recorded, in addition to high level of phenolic compounds (170mg/100g) which suggests that the seed could possess good antioxidant properties. The above findings are indications that great potential exists for wild black plum seed as good source of nutrients and phytochemicals.*

Keywords: *Black plum seed; Amino acid; Mbembe; Fatty acids; Vitex doniana.*

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I. Introduction

Black plum (Vitex doniana) is a perennial shrub widely distributed in tropical West Africa, extending eastward to Uganda, Kenya and Tanzania in Savanna and high rainfall area[1]. It is commonly known as black plum or African olive[2], and as Mbembe in Ebonyi State, Nigeria, where it abounds in the wild. The plant is a deciduous tree with heavy rounded crown, and can grow up to 25 metres tall. The bole can be clear of branches for up to 5 metres[3]. The fruits (mbembe) are oblong drupe 2-3cm long, green when immature, turning purplish-black on ripening. They are usually eaten as snack either fresh or dried, and have a sweet prune-like taste with velvet-like texture. The leaves of vitex doniana have been reported to have anti-malaria and anti-dysentery properties[4]; the stem bark, anti-hepatotoxic[5] and anti-bacterial[6]; while the fruit pulp has been reported as good source of phytochemicals and nutritional compounds[7]; yet not much attention has been focused on the seed.

The importance of some Nigerian wild seeds as rich sources of oil, protein, fibre and minerals for human consumption and animals feed has been reported[8]. Ikram et al.[9] noted that neglected and underutilized fruit seeds do not receive much attention due to lack of information on their nutritional compositions and physical qualities; and lack of promotional campaign for these fruit seeds. Fruit seeds on the other hand, can have high content of toxic and anti-nutritional substances but could still be good sources of economically valuable compounds for non-edible purposes.

Black plum is among the numerous indigenous tropical fruits highly cherished for their pulps. In Ebonyi State where this fruit abound, the seed is usually discarded as waste after consumption of the fruit pulp due to lack of information on possible usefulness of the seed. The present study explores the possible usefulness of wild black plum seed from Ebonyi State by evaluating some nutritional and phytochemical compositions of the seed.

II. Materials and Methods

2.1 Source and Preparation of Sample

Matured plum (Vitex doniana) fruit was harvested from tree grown wild in Afikpo, Ebonyi State. The fruit was manually peeled to expose the pulp (edible part) which was removed to obtain the nut; this was further cracked open with the aid of hammer, to obtain black plum seed. The seed was sundried to constant weight, milled in a blender and subjected to analyses as outlined below.

2.2 Analysis of Samples

Proximate composition was evaluated according to AOAC official methods of analysis[10]. Crude protein content was determined using Kjeldahl method; crude fat was determined by Soxhlet extraction method; ash by incinerating samples at 600^{o}C in a muffle furnace and moisture content by drying in a convention oven; while carbohydrate was calculated by percentage difference.

Total phenol was evaluated colorimetrically at 725nm using Folin-Ciocalteau reagent[11]. Exactly 0.1ml of black plum seed extract was measured into 10-ml volumetric flask, then 5ml of distilled water and exactly 0.5ml Folin-Ciocalteau reagent were added. The flask was inverted (about 4 times) and allowed to sit for 3 min. At the end of 3 min, exactly 1ml of Na_2CO_3 was added and the solution was diluted to volume with distilled water, and then stored in the dark for 1 hour. After 1 hour the absorbance of the solution at 725nm was measured using reagent solution (prepared in the same manner as the sample) as blank. Concentrations of total phenolic compounds were calculated from calibrated curve of gallic acid standard, in the range 10-100µg/ml (r^2 = 0.9988). Results are expressed as gallic acid equivalence.

The fatty acid profile of oil extracted from black plum seed was evaluated by GC analysis of methylated sample according to AOCS Official Method Ce 1h-05[12]. Fatty acid methyl esters (FAMEs) were analyzed on a HP 6890 GC system from Hewlett Packard, using a DB-23 capillary column (60m x 0.32mm x 0.25µm film thickness) from Agilent Technologies. FAMEs were identified by comparison with the retention times of a standard mixture of 37 fatty acid methyl esters (Supelco, Germany). All reagents were of analytical grade and purchased from Merck (Darmstadt, Germany).

Amino acids of defatted and hydrolysed black plum seed samples were measured according to the procedure reported by Mohammed et al.[13], using Sequential multi sample (TSM) amino acid analyser; Alkaloids were determined gravimetrically following the method described by Harbone[14]; while Total flavonoids were determined by the gravimetric method, according to the method described by Bohm and Koupai-Abyazani[15].

III. Results and Discussion

3.1 Characteristics of wild black plum seed

The nutritional, phytochemical and fatty acid profile of wild black plum seed used in this study are shown in table 1, while the amino acid profile is shown in table 2. Moisture content of 8.25% was recorded for the wild seed and falls within range expected for fruit seeds. The ash content which is a measure of the total amount of minerals present within a food, was 5.18% and is comparable to that reported for pumpkin seed[16] and melon seed[17]. The ash content presented in Table 1 suggests that wild black plum seeds contain reasonable amount of minerals.

Table 1. Characteristics of wild black plum seed.

Parameter[a]	Concentration
Proximate (%)	
Moisture	8.25
Ash	5.18
Crude fat	36.52
Fibre	4.84
Protein	27.57
Carbohydrate	17.64
Phytochemical (mg/100g)	
Alkaloid	11.40
Flavonoid	3.75
Total phenolic content[b]	170
Fatty acid profile (%)	
Palmatic (16:0)	34.24
Stearic (18:0)	7.22
Oleic (18:1)	58.54
Linoleic (18:2)	Not detected
Linolenic (18:3)	Not detected

[a]Values are means of duplicate analysis. [b]Expressed as gallic acid equivalence.

Table 1 also shows that the fat content of the seed was 36.52%. This value is higher than those of common oilseeds such as cottonseed (18-20%) and soybean (18-20%), and comparable to values reported for safflower seed (30-35%) and sunflower seed (35-40%)[18]. The seeds of wild black plum can therefore be considered a good source of fat. Fatty acid profile of the seed (table 1) indicates that oleic acid (18:1) and palmitic acid (16:0) are the predominant fatty acids, making up 58.54% and 34.24% respectively, of the total fatty acids of the seed oil. Similar levels of oleic acid have been reported for fruit seed oils from mango, cherry, date and apple seeds[19]. It is interesting to note that polyunsaturated fatty acids (18:2 and 18:3) were not detected in the seed oil. Considering that the rate of oxidation of oil is directly related to its degree of unsaturation, the oil

from wild black plum seed can be considered oxidatively stable due to the absence of linoleic and linolenic acids which are prone to rapid oxidation, compared to oleic acid.

Fibre content of the seed was 4.84% (table 1), and can be considered to be on the low side when compared to fibre contents of fruit seeds such as cherry, water melon, pawpaw and guava seeds with their respective values of 10, 14, 14, and 12%[17]. Although fibre is known for its benefits in the body such as prevention of constipation, lowering of blood cholesterol and reducing the risk of various cancers; yet emphasis has been placed on the importance of keeping fibre intake low in the nutrition of infants and weaning children because high level in diet can lead to irritation of gut mucosa in children[20].

High protein content of 27.57% was recorded for the seed as shown in table 1. This value exceeds those of legumes such as beans (19.4-24.8%) and peas (23.9-25.1%) and thus suggests that the seed of wild black plum is a rich source of protein. Further analysis revealed 18 amino acids making up the protein (table 2), of which 46.28% are essential and 53.72% non essential amino acids. Among the essential amino acids, threonine (7.55%) and methionine (6.22%) were the most abundant, while proline (8.64%) and glutamic acid (7.33%) were the predominant non essential amino acids. The amino acid profile as shown in table 1 indicates that wild black plum seed is also a good source of essential amino acids.

Table 2: Amino acid profile of black plum seed (g/100g)[a]

Non essential		**Essential**	
Alanin	2.71	Histidine	3.25
Asparagine	4.53	Isoleucine	3.95
Aspartic acid	5.51	Ieucine	5.31
Glutamic acid	7.33	Lysine	4.92
Serine	3.18	Methionine	6.22
Arginine	4.26	Phenylalanine	2.85
Cysteine	1.07	Threonine	7.55
Glycine	3.48	Valine	3.12
Proline	8.64		
Tyrosine	2.43		
Total AA	43.14		37.17
% Total AA	53.72		46.28

[a]Values are means of duplicate analysis. AA= amino acid.

The calculated value for carbohydrate was 17.64% and is relatively low when compared to fat and protein contents (table 1). Furthermore carbohydrate content of wild black plum seed can be considered on the low side when compared to levels reported for pawpaw seed (36.2%)[17] and dabai seed (44.6%)[21].

Among the phytochemicals, phenolic compounds were the predominant, followed by alkaloid; and flavonoid representing a smaller portion (table 1). The amount of phenolic compounds recorded (170mg GAE/100g) is higher than values reported for Ocimun basilicum, Apium graveolens and Lepidium sativum seeds (51-92mg GAE/100g)[22] and for Okra (Abelmoschus esculentus) seed (142.48mg GAE/100g)[23]. Phenolic componds have been reported as natural antioxidants effective in inhibiting lipid oxidation by donating hydrogen atoms to lipid alkyl, alcoxyl and peroxyl radicals[24]. Hence, the presence of appreciable amount of phenolic compounds suggests that the extract of this wild seed can serve as effective natural antioxidant. The level of flavonoid obtained for black plum seed was 3.75mg/100g, which is four times lower than the value reported for water melon seed[25] but comparable to the flavonoid content reported for voandzeia susterranea seed (4.93%)[26]. Flavonoids have been reported as potent free radical scavengers which prevent oxidative cell damage; and as having strong anticancer activity protecting against all stages of carcinogenesis[27]. Table 1 also shows alkaloid content of 11.4mg/100g, which is comparable to literature values for alkaloid contents of melon seed and Ben oil seed[25]. It has also been reported that alkaloids are used as basic medicinal agents for their analgesic and bactericidal effects[28].

IV. Conclusion

The present study provides evidence that the seed of wild black plum has potential as good source of nutrients and phytochemicals. The high fat content classifies the seed as an important oilseed while the fatty acid profile places the seed oil among vegetable oils with balanced saturatation/unsaturation ratio. The protein content and amino acid profile indicate that the seed is a good source of protein and particularly a good source of essential amino acids. The ash content indicates that the seed can serve as a good source of minerals, while the high level of phenolic compounds suggest that the seed could be a good source of natural antioxidant which may be effective in inhibiting lipid oxidation and in preventing the formation of free radicals in human body. The above findings stress the importance of this neglected wild black plum seed and further constitute a starting point which could lead to exploitation of this seed as a good source of economically valuable compounds for edible purposes (or at least for non edible purposes).

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