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Research Article

Determination of Nutritional and Phytochemical Compositions of Two Variants of Bitter Leaf (Vernonia amygdalina Del)

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Abstract

Nutritional and phytochemical compositions of the leaves, stem and root of sweet and bitter variants of *Vernonia amygdalina* Del. were determined. The samples were oven-dried at 60°C for 24 hours and the standard methods of analyses were adopted. Values were considered significantly different at ($p<0.05$).Sweet variant has the greater values of tannin in leaves and root; protein in stem and root and carbohydrate in leaves, whereas bitter variant has higher levels of crude fibre and fat in the leaves and carbohydrate in the stem and root. Hydrogen cyanide concentrations present in the leaves and stem of both variants of *Vernonia amygdalina* were low. There was high level of alkaloids in the parts of the two variants, with higher proportion in the leaves of the bitter variant; which could be the cause of the its bitterness. The negligible variation in the nutritional and phytochemical constituents of parts of these variants indicated that they could be used as food and drug in ethnobotany, interchangeably.

INTRODUCTION

Vernonia amygdalina Del. is a medium sized shrub with abundant bitter principles in every part of it. It belongs to the family Compositae or Asteraceae. The plant is known as "Ewuro", "olugbu" and "shuwakaa" in Yoruba, Western; Igbo, Southern and Hausa, Northern Nigeria, respectively. It is a widely used local plant in Southern Nigeria for both therapeutic and nutritional purposes. Bitter leaf decoction of the plant is ethno medicinally employed as an anti-diabetic remedy [1]. It is also used as a local medicine against leech in some countries [2].

Meanwhile, confusion exists in Nigeria even among the natives, as to the correct identity between *Vernonia amygdalina* and *Vernonia colorata*. The natives, based on the bitterness of the leaves, were able to distinguish between bitter and sweet varieties of *Vernonia amygdalina*. Some workers were of the view that both *Vernonia amygdalina* and *Vernonia colorata* are mistaken for each other since they possess similar morphological characters, as well as high bitter taste [3,1]. They are regarded as substitutes to quinine. In addition, Etukudo [4] was of the opinion that *Vernonia colorata* is less bitter than *Vernonia amygdalina*. He also stated that *Vernonia calvoana* was a close ally of the other two. The importance of this study was therefore to find out whether there are differences between the nutritional and photochemical compositions of the bitter and sweet variants of *Vernonia amygdalina*, in order to ascertain whether they could be used interchangeably as food and drug in ethno botany.

MATERIALS AND METHODS

Plant materials

The leaves, stem and root of both sweet and bitter variants of *Vernonia amygdalina* used for this study were obtained from the premises of the National Root Crop Research Institute, Umudike, Abia State, Nigeria. The voucher specimens were deposited in the Herbarium of Abia State University, Uturu, Nigeria.

Preparation of plant materials

Two hundred gram (200g) of the seeds, leaves, stems and roots used were oven-dried at 60°C for 24 hours.

Preliminary phytochemical tests

The preliminary phytochemical tests for the presence or absence of alkaloid, saponin, flavonoid, sterols and triterpenes, tannins, glycoside and starch were carried out following standard methods of Beckett and Stenlake [5].

Quantitative phytochemical tests

The quantitative phytochemical tests were conducted using a standard method [6].

Proximate analyses

Proximate analyses of the test samples were conducted following the standard methods of Ene-Obong and Carnovale [7].

Statistical analysis

All values were subjected to statistical analysis using SPSS software, 2001version. They were checked for normality (Kolmogorov–Smirnov test) and tested for homogeneity (Leven median test). F-Test was then used to analyze the data at $p<0.05$. Duncan's multiple range test (DMRT) was used to separate the means and data were expressed as mean ± standard deviation of triplicate determinations.

RESULTS

The results of the study of the two variants of *Vernonia amygdalina* are in Tables 1,2. Concentration of alkaloid was higher in the leaves of bitter variant. There was no significant difference between the alkaloid contents of the stem as well as those of the root of the two variants. Tannin levels of the leaves (0.16±0.02%) and root (0.18±0.02%) of the sweet variant were higher than those of the leaves (0.10±0.01%) and root (0.08±0.02%) of bitter variant. No significant difference existed among the tannin levels of stem of both sweet and bitter variants. There was also no significant difference between the saponin contents of the leaves as well as the anthocyanins values of the leaves, stem and root of the two plants. There were traces of steroids and tritepenes in the leaves and stem of the bitter and sweet variants but absent in their roots. Starch was absent in the root of the two plants and there was no significant difference in the values of the leaves and stem. Reducing sugar was absent in the leaves and stem of the two plants with no significant difference between the contents of the root. There was no significant difference in the flavonoid level of the leaves, stem and root of both sweet and bitter variants. There was absence of hydrogen cyanide in the leaves and stem of both sweet and bitter variants with no significant difference in the root contents (Table 1).

There was no significant difference between the protein content of the leaves of both plants. The protein levels of the stem and root of the sweet variant were higher than those of the bitter variant. Crude fiber and fat contents of the leaves of bitter variant (10.86±0.01%; 2.72±0.00%) were higher than those of sweet variant (6.84±0.00%; 1.66±0.00%) respectively; whereas significant difference did not exist in the crude fibre and fat values of the stem and root of the two plants. Levels of ash were higher in the leaves and stem of the bitter variant. There was significant difference in the carbohydrate values of all the parts with greater value in the leaves of sweet variant; stem and root of bitter variant. The energy value of the leaves of sweet variant was greater than that of bitter variant whereas the stem and root of bitter variant have the higher values. Moisture contents of the leaves, stem and root of the bitter variant were higher than those of sweet variant while the dry matter levels of the leaves, stem and root of sweet variant were greater (Table 2).

DISCUSSION

Levels of alkaloids were highest when compared with others in all the parts of sweet and bitter variants of *V. amygdalina* investigated. In addition, their level in the leaves of bitter variant was higher than that of sweet variant, which is probably the cause of the bitterness of the former. Alkaloids have been reported to uniformly invoke a bitter taste [8]. Generally, the two variants have rich phytochemical constituents, of which attributed to several ethnomedicinal uses of different parts of *Vernonia amygdalina* in Nigeria, presumably. The leaves are used for treatment of abdominal pain, cough, diabetes, diarrhoea, diuretic, fever, kidney and urinary problem, increase lactation, stomach ulcer, painful uterus, venereal disease and anti aging [9]. In addition, the roots and leaves are used for infertility in women and weak joints; roots for aphrodisiac and amenorrhea; leaves and stem for oedema. Lipid lowering effects of both aqueous and methanol extracts of *V. amygdalina* leaves have been reported [10,11]. The aforementioned medicinal usefulness of these

Table 1: Phytochemical composition (%) of the leaves, stem and root of sweet and bitter variants of *Vernonia amygdalina*.

Compositions	Sweet variant			Bitter variant		
	Leaves	Stem	Root	Leaves	Stem	Root
Alkaloids	1.24±0.03^a	1.12±0.01^b	1.26±0.04^c	1.38±0.01^d	1.14±0.01^b	1.28±0.01^c
Tannins	0.16±0.02^a	0.12±0.00^b	0.18±0.02^a	0.10±0.01^b	0.08±0.02^b	0.08±0.02^b
Saponins	0.12±0.02^a	0.08±0.03^a	0.08±0.04^a	0.08±0.01^a	0.06±0.03^b	0.04±0.01^b
Anthocyanins	0.08±0.01^a	0.06±0.04^a	0.06±0.01^a	0.08±0.03^a	0.06±0.03^a	0.04±0.02^a
Sterols and Tritepenes	-	-	Trace	-	-	Trace
Starch	0.32±0.00^a	0.12±0.01^b	-	0.26±0.02^a	0.12±0.03^b	-
Reducing sugar	-	-	1.24±0.03^a	-	-	1.22±0.00^a
Flavonoids	0.18±0.01^a	0.08±0.02^b	0.14±0.04^a	0.18±0.02^a	0.12±0.01^b	0.14±0.00^a
HCN (Mg/100g)	-	-	0.04±0.01^a	-	-	0.06±0.03^a

Data are mean±standard deviation of triplicate determinations. Figures with different superscripts along the same row are significantly different at ($p>0.05$).

Table 2: Nutritional composition (%) of the leaves, stem and root of sweet and bitter variants of *Vernonia amygdalina*.

Composition	Sweet variant			Bitter variant		
	Leaves	Stem	Root	Leaves	Stem	Root
Protein	25.20±0.03[a]	7.00±0.01[b]	3.15±0.01[c]	22.05±0.00[a]	5.95±0.01[d]	2.80±0.00[e]
Fat	1.66±0.00[a]	0.28±0.02[b]	0.22±0.01[b]	2.72±0.00[c]	0.32±0.01[b]	0.22±0.02[b]
Crude fibre	6.84±0.00[a]	38.62±0.01[b]	58.28± 0.03[c]	10.86±0.01[a]	36.94±0.01[b]	56.22±0.01[c]
Ash	8.96±0.00[a]	6.36±0.00[b]	7.44±0.00[c]	9.24±0.01[d]	7.22±0.00[c]	9.18±0.02[d]
CHO (NFE)	57.34±0.02[a]	47.72±0.02[b]	30.91±0.01[c]	55.13±0.03[d]	49.57±0.00[e]	31.80±0.01[f]
Energy Kcal/g	345.10±0.00[a]	220.0±0.02[b]	138.22±0.00[c]	320.44±0.01[d]	224.96±0.03[e]	153.84±0.00[f]
Moisture	65.36±0.00[a]	42.86±0.03[b]	26.42±0.01[c]	67.16±0.02[d]	44.86±0.00[e]	31.42±0.01[f]
Dry matter	34.64±0.01[a]	57.14±0.00[b]	73.58±0.02[c]	32.84±0.00[d]	55.14±0.01[e]	69.58±0.00[f]

Data are mean±standard deviation of triplicate determinations. Figures with different superscripts along the same row are significantly different at (p>0.05).

plants might be basically as a result of the alkaloid, flavonoid, saponin and tannin contents of the plants. The use of the leaves for treatment of abdominal pain and painful uterus might be as a result of the analgesic property of alkaloid [12]. The usefulness of the leaves as anti aging agent might be as a result of the flavonoid content of the plants. Flavonoids act as free radical scavengers [13,14]. Saponins have been found to be potentially useful for the treatment of hypercholesterolemia which suggested that saponin might be acting by interfering with intestinal absorption of cholesterol, thus have antidiabetic effects [15,16]. The utilization of these plants in treatment of diarrhoea is probably attributed to the anti-diarrhoea property of tannin. Tannin was reported to possess anti-diarrhoea ability [17,18].

In addition, high value of protein in the leaves of these plants presented them as excellent sources of it of which there is search for food materials with high protein contents which would be used to enrich our staple starchy foods. Higher ash content of the bitter variants suggested that it has a greater level of minerals. Generally, the nutritional compositions of the two variants were rich. These suggested that they could be used as food. The leaves of bitter variant of *V. amygdalina* are squeezed in order to remove the bitter taste and used in preparation of 'ofe onugbu', a popular delicacy in South Eastern Nigeria. The leaves and shoots are regarded as good fodder for goats.

CONCLUSION AND RECOMMENDATION

The different proportions of alkaloids in the leaves, stems and roots of both sweet and bitter variants of *V. amygdalina* might be the major contributing factor to the difference in their taste. In addition, alkaloid is rich in the parts of both bitter and sweet variants, and could serve as good sources of it for pharmaceutical application. Although hydrogen cyanide was detected in the root of the two variants of *Vernonia amygdalena*, the concentration was negligible. Generally, there were negligible variations in the phytochemical and nutritional compositions of the various parts of sweet and bitter variants, which suggested that they could be used interchangeably in ethnobotany as food and drug.

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