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REGULAR ARTICLE

EFFECT OF DRYING ON THE NUTRIENT COMPOSITION OF *VERNONIA AMYGDALINA* LEAVES

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SUMMARY

Vernonia amygdalina (Bitter leaf) is a common and popular vegetable among the people of Nigeria used as a spice in many delicacies. In this study, the effect of solar, sun and oven drying methods on the proximate and mineral contents of its leaves was evaluated using standard analytical procedures. Drying increased significantly ($P<0.05$) the concentration of most of the organic constituents evaluated. The protein content was markedly enhanced by drying and it range from 1.31% in fresh sample to 5.30% in sun dried samples. A significant ($P<0.05$) increase in mineral content was observed upon drying except magnesium, whose concentration was found to be high (0.23 mg/100g) in fresh sample. The concentrations of Zn and Cd increased upon drying while, that Pb, Cr and Cu contents decreased. The results of this study suggest that drying improve the concentration of both organic and mineral constituents and solar drying method could be useful in preserving V. amygdalina leaves in a more hygienic way and ensure its all-the-year–round availability.

Keywords: *Vernonia amygdalina*, Asteraceae, Drying, nutrient, Vegetables.

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1. Introduction

Vernonia amygdalina Del. is a common and popular vegetable among the people of West Africa. It is also used as a spice in many delicacies. In Nigeria, Ghana and Cameroon the plant is grown in the garden and around the homestead for a quick supply. The common medicinal uses of *V. amygdalina* include, anti malarial, anthelmintic, antidiarrheal, treatment of venereal diseases, gastrointestinal problems and wounds. The vegetable is consumed after a debittering process that removes the astringent component of the bitter leaf [1-4]. The plant species is also a potential substitute for hops in tropical beer brewing [5]. In addition, it is used as a food substitute for broilers as it is capable of replacing 300 g/kg of maize-based diet without affecting feed intake, body weight gain and feed efficiency [1]. The role played by this plant in traditional medicine as well as in nutrition is enormous and well documented.

Traditionally, sun drying is employed for preserving a variety of foodstuff and

in so doing, food stuff could be contaminated during the process because they are normally dried in an open environment. Drying leafy vegetable increases their shelf life span upon storage [6, 7]. Drying has been used as a method of preserving food stuffs [8] and vegetables usually deteriorate by micro-organisms [9] due to favourable environmental factor such as moisture [10, 11]. Preservation makes food safe for consumption by destroying pathogenic micro-organisms [12].

Vernonia amygdalina leaves are more abundant during the rainy season and less during the dry season in most cases. An important challenge to ensuring food security in most developing societies is making food available all year round. To ensure availability of *V. amygdalina* all year round, the need for an efficient preservation method is crucial. The objective of this work was to evaluate the effect of drying methods on the proximate and mineral nutrient content of *V. amygdalina* leaves.

2. Materials And Methods

Collection and drying of plant material

The fresh leaves of *Vernonia amygdalina* were collected from a garden at Sokoto Police Barrack, opposite temporary site of the Usmanu Danfodiyo University, Sokoto. The leaves were processed and dried in an oven at 60^{o}C for 24 hours, solar dried between 32-34^{o}C for 8 hours and sun dried to a constant weight.

Proximate and mineral analysis

Ash determination involved the incineration of the samples in a snuffle furnace at 600^{o}c for 3 hours. The total N content in the digests were determined by microkeldahl nitrogen method as total Kjeldahl nitrogen (TKN). The crude protein was obtained by multiplying TKN values by a conversion factor of 6.25 [13]. Crude lipid was determined by extracting the sample with n-hexane in a Soxhlet extractor. Crude fibre was estimated according to AOAC [13].

The mineral constituents were determined by digesting the sample on a labcon digester at 300oC in a mixture of hydrogen peroxide, sulphuric acid, selenium and salicyclic acid [14]. The digests were analysed for total P, Na, Ca, Mg and extractable micronutrients of Cd, Zn, Pb, Cu, and Cr. Total phosphorous was determined using the phosphor-Vernadomolybdate procedure and Ca and Mg by titration method using Ethylenedia minetetra acetic acid (EDTA) solution and Na and K by flame photometry and the absorbance measured at 880 nm. The contents of Mn Cd, Zn, Pb Cu, Cr and Fe were determined using Chimadzu Atomic Absorption Spectrophotometer adopting the methods [15].

Statistical analysis

The data collected was subjected to Analysis of Variance (ANOVA) and the differences between means were assessed by Duncan's new multiple range test using the statistical package stats graphics 2000 at $p < 0.05$.

3. Results and Discussion

The result of proximate analysis of *V. amygdalina* leaves samples analyzed is presented in Table 1. Moisture removal by heat generally improve the digestibility of foods, increases concentration of nutrients and can make some nutrients more available [16]. The moisture content was high in the fresh sample and was significantly ($P<0.05$) decreased with different drying methods. Moisture content of fruits and vegetables provide an enabling environment for growth of micro-organisms [11] and preservation by drying help to inhibit autolytic enzymes

[17]. Drying has been reported to be effective in reducing moisture content and make the preservation possible without deterioration by micro- organisms [8]. The ash content was significantly (P<0.05) high in all the drying methods in comparison with fresh leaves. Although, ash content is an index of total mineral element, it is also used to test the extent of contamination with sand from the surroundings [12]. In this study, ash content ranged from 10.90-11.70% and was found to be high in sun dried samples. This observation is therefore not surprising as vegetables are exposed to uncontrolled dust during drying process. Similarly, lipid content was significantly higher (P<0.05) in all the drying methods. Although, protein is known to decrease upon drying due to the application of heat [16], in this study, protein content increased markedly upon drying which range from 1.31% in fresh sample to 5.30% in sun dried samples. The fibre content was significantly higher (p<0.05) in all the drying methods with 4.50 % in oven and sun dried samples as compare to the fresh sample with 1.50%.

Table 1: Proximate composition (%) of *V. amygdalina* leaves as affected by drying methods.

Drying method	Protein	Carbohydrate	Ash	Fibre	Moisture	Lipid
Fresh	1.31 ± 0.01^{c}	87.27 ± 7.19^{a}	2.50 ± 0.00^{c}	1.50 ± 0.05^{b}	75.00 ± 11.69^{a}	0.50 ± 0.00^{c}
Oven	5.12 ± 0.02^{a}	66.45 ± 11.32^{b}	10.90 ± 0.71^{b}	4.50 ± 0.00^{a}	20.23 ± 0.01^{b}	2.80 ± 0.29a
Solar	3.76 ± 0.06^{b}	55.25 ± 0.98^{c}	11.00 ± 0.50^{b}	3.70 ± 0.50^{b}	23.70 ± 0.01^{b}	2.70 ± 0.29^{a}
Sun	5.30 ± 0.00^{a}	49.01 ± 0.50^{d}	11.70 ± 0.29^{a}	4.50 ± 0.00^{a}	14.61 ± 0.16^{b}	1.30 ± 0.29^{b}

Values are means ± standard deviation. Means with the same letter (s) on a column are not significantly different using the method of least significant difference (LSD) at 5% probability.

Table 2: Effect of drying methods on the mineral contents (mg/100g) of *V. amygdalina* leaves.

Drying methods	Calcium	Magnesium	Potassium	Sodium	Nitrogen	Phosphorous
Fresh	0.16 ± 0.01^{c}	0.23 ± 0.01^{a}	0.97 ± 0.06^{c}	1.13 ± 0.06^{d}	0.57 ± 0.63^{c}	3.40 ± 0.12^{b}
Oven	0.22 ± 0.00^{a}	0.15 ± 0.02^{b}	4.37 ± 0.12^{a}	3.93 ± 0.06^{a}	0.82 ± 0.00^{b}	3.60 ± 0.17^{a}
Solar	0.21 ± 0.01^{a}	0.17 ± 0.02^{b}	1.93 ± 0.06^{c}	2.73 ± 0.12^{c}	1.63 ±1.78^{a}	3.70 ± 0.44^{a}
Sun	0.19 ± 0.01^{b}	0.20 ± 0.01^{c}	3.83 ± 0.06^{b}	3.13 ± 0.06^{b}	0.85 ± 0.00^{b}	3.40 ± 0.12^{b}

Values are means ± standard deviation. Means with the same letter (s) on a column are not significantly different using the method of least significant difference (LSD) at 5% probability.

The result of mineral analysis indicated significant differences (P<0.05) in the drying methods employed except magnesium which was found to be high in fresh sample (Table 2). The daily intake of magnesium was recommended to be 350 mg/100g and this study indicated range of 0.15-0.23 mg/100g which is low comparatively to the daily intake and this signifies that *V. amgydalina* is not a good source of magnesium. The potassium content in the samples analyzed ranged from 0.97- 4.37 mg/100. Potassium in form of K+ is the must essential cation of the cell [18]. Sodium content ranged from 1.13-3.93 mg/100. Calcium and potassium are linked with physiological development of bone, teeth and muscles and are both associated with Vitamin D metabolism [17]. The concentration of this element in *V. amgydalina* ranged from 0.16-0.22 mg/100g. This value was reported comparatively lower to the value reported [19].

The concentration of heavy metals as affected by the different drying methods is presented in Table 3. Drying decreased the concentration of heavy metal analyzed except cadmium and Zinc which increases

upon drying. The sun dried samples had the highest concentration of cadmium and zinc with 0.08 and 12.09 mg/100g respectively. The relatively high content of zinc and cadmium upon drying may be attributed to contamination during drying process. Although, zinc is nutritionally important for its roles in immune system [20], for insulin secretion [21], in the release of vitamin A from the liver [22] and as an enzyme [23], its high concentration is noteworthy.

Table 3: Concentration of heavy metals (mg/100g) in *V. amygdalina* leaves as affected by drying methods.

Parameter	Cd	Zn	Pb	Cr	Cu
Fresh	0.01 ± 0.01	5.13 ± 0.00	0.06 ± 0.00	0.07 ± 0.00	0.29 ± 0.00
Oven	0.06 ± 0.06	7.61 ± 0.00	0.05 ± 0.00	0.04 ± 0.00	0.15 ± 0.00
Solar	0.03 ± 0.03	7.14 ± 0.00	0.01 ± 0.00	0.05 ± 0.00	0.10 ± 0.00
Sun	0.08 ± 0.08	12.09 ± 0.00	0.04 ± 0.00	0.04 ± 0.00	0.18 ± 0.00

Values are means ± standard deviation (n = 3).

The results of this study suggest that drying could improve the concentration of both organic and mineral constituents and solar drying method could be useful in preserving *V. amygdalina* leaves in a more hygienic way and ensure its all-the-year–round availability. The development of *V. amygdalina* in sustainable agricultural development in Nigeria would transcend the ethnic popularly and create a worldwide market for the plant and its products. The cultivation of *V. amygdalina* for macro and micro nutrients augmentation programme in Nigeria and other West African countries is advocated.

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