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5 authors, including:

Ajiboye Basiru
Afe Babalola University

Emmanuel Ibukun
Federal University of Technology, Akure

Genevieve Edobor
University of Salzburg

Oluwafemi Adeleke Ojo
Afe Babalola University

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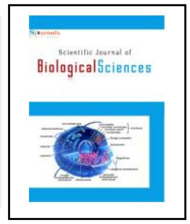

Original article

Chemical composition of Senecio biafrae leaf

B.O. Ajiboye[a,]*, E.O. Ibukun[b], G. Edobor[a], A.O. Ojo[a], S.A. Onikanni[a]
[a]*Department of Chemical Sciences, Afe Babalola University, Ado-Ekiti, Ekiti State.*
[b]*Department of Biochemistry, Federal University of Technology, Akure, Ondo State.*

*Corresponding author; Department of Chemical Sciences, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria; Tel: +23470-3902-7683.

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A B S T R A C T

This study examined the proximate, mineral, fatty acid, amino acid and vitamin compositions of Senecio biafrae leaves grown mostly in western part of Nigeria. From the results, Senecio biafrae leaves were found to be a good source of protein (14.26±2.01%) and fiber (15.78±0.13%) by using AOAC method. The observed minerals content carried out using atomic absorption spectrophotometer were: sodium, iron, potassium, aluminum, calcium, zinc, selenium, magnesium and cobalt. The leaves also has essential fatty acid by using gas chromatograph technique (Linoleic, linolenic and arachidonic acids), indispensable amino acid (threonine, valine, isoleucine, leucne, tyrosine, phenylalanine, tryptophan and histidine) which was determined by using gas chromatography technique and vitamins such as vitamins E, C, K, A and vitamin B complex was detected by using both AOAC and gas chromatography technique.. Therefore, Senecio biafrae can be considered as a useful source of essential nutrients for both animals and livestock.

1. Introduction

Due to inadequate consumption of essential nutrients (most especially in less developed countries) is very important in assessing the alternate source (Muhammad and Ajiboye, 2010). Vegetables most especially green leaf are one of the sources of nutrients for growth of both man and livestock animals (Dairo and Adanlawo, 2007).

Vegetables are generally succulent parts of plants grown in gardens and consumed as a side dish with starchy staples (Guarino, 1995). Green leafy vegetable constitutes an indispensable part of human diets generally in most part of Africa, especially in Nigeria. In addition, green leafy vegetables are used in the diets of postpartum women during which time it is claimed that they aid the contraction of the uterus (Emebu and Anyika, 2011). Also, studies have shown a progressive per capital daily consumption of vegetables from 65 g in 1977 to 360 g in 1989 (Fafunso and Basir, 1977; Oguntona et al., 1988), although there are no recent statistics on vegetable consumption (Dairo and Adanlawo, 2007).

The abundance of vegetables in Nigerian markets is an indication of their usefulness in human diets. Senecio biafrae (with local name "worowo" or Sierra Leone bologni) belong to this group of vegetables that grow in large quantity as undercover in tree crop plantation. Some of these leafy vegetables are also considered for their high medicinal value as the juice extracted from the leaves are wholly applied to fresh wounds or cuts as styptic in the rural community for man and animal use (Akah, 1996; Viana, et al., 2003; Gulliice et al., 2004; Okpara et al., 2006; Dairo and Adanlawo, 2007). The high edible mucilaginous fibre, leaves and stem are used to treat indigestion or as laxative and as purgative (Fowomola and Akindahunsi, 2005). Moreover, fresh succulent leaves of Senecio biafrae are used as a leafy vegetable in Sierra Leone, Ghana, Benin, Nigeria, Cameroon and Gabon. They are especially popular in south-western Nigeria. They are usually cooked with pepper, tomato and onions. In such dishes there is no need for meat or fish because of the excellent properties of the vegetable, reflected in the Yoruba proverb 'vegetable soup prepared with Senecio biafrae does not need meat'(Stevels, 1990). However, fish or meat may be added to the soup. In Sierra Leone, where it is called 'bologi', the leaves are eaten as a steamed vegetable in combination with okra and fish. They are first steamed in boiling water and later squeezed to remove the mucilage from the leaves (Stevels, 1990). The squeezing is followed by 2–3 rinses with cold water to remove the mucilage as completely as possible. An infusion of the leaves is taken as a drink. Among the Yoruba speaking people of south-western Nigeria, a leaf extract of Senecio biafrae is used to stop bleeding from cuts or injury and in Sierra Leone and Cameroon a leaf extract is used to treat sore eyes. In Côte d'Ivoire pulped leaves are applied to the breasts as a galactagogue. In Congo Senecio biafrae is used to treat cough and heart troubles, as a tonic and to relieve rheumatic pain, prurient allergies and localized oedemas (Stevels, 1990). In Congo it also has cultural uses in initiation and funeral rituals and in Yoruba culture it is associated with rituals to ward off smallpox (Adebooye, 2004). Therefore, the objective of this study is to provide information on the nutritional composition of Senecio biafrae leaf.

2. Materials and methods

Samples of Senecio biafrae leaves were obtained from Oja-Oba Market in Ado-Ekiti, Ekiti State, Nigeria. Senecio biafrae leaves was authenticated at the University of Ilorin where a voucher number was given. The leaves were then dried in an oven at 50^{0C}, these were then milled using a blender and the powder were then used for the analyses

2.1. Proximate analysis

The crude protein, lipids, fiber and ash were determined in triplicate using the methods describes by AOAC (1990), while the carbohydrate content was determined by difference method (calculated by subtracting the sum of crude protein, crude fat, crude fiber and ash from total dry matter content). Also, the concentration of the milled samples was determined by the micro-kjeldahl method and multiplied by 6.25 to estimate the crude protein content. The lipid content was estimated by the usual procedure of continuously extracting the fat content of the sample using continuous extracting the fat content of the sample using petroleum ether (40-60^{0C}) as a solvent in a soxhlet extractor. Crude fiber was determined by defatting a known weight of the sample with petroleum ether. The defatted sample was boiled under reflux with H_2SO_4, filtered and washed with boiling water till the filtrates were no longer acidic. Then, the residue was boiled with NaOH, filtered and washed with boiling water till the filtrates were no longer basic. The residue was dried in an oven at 100^{0C}, cooled in a desiccator and weighed. This was finally incinerated in a muffle furnace at about 600^{0C}, cooled in a desiccator and weighed. In addition, the ash content was estimated by heating a known weight of the sample inside a pre-weighted porcelain crucible in a muffle furnace at 600^{0C}.

2.2. Mineral determination

0.2g of the ashed samples was weighed into the precleaned borosilicate 250ml capacity beaker for digestion. 30ml of the nitric acid was added into the weighed sample in the beaker. The sample with the digesting solvent was placed on the hot plate for digestion in the fume cupboard and allowed to cool. Also, another 20ml of the digesting solvent was added and digested further in the fume cupboard. The mixture was then allowed to cool at room temperature. This was filtered into 250ml standard volumetric capacity borosilicate container, and made up to the mark level with deionized water. Furthermore, the digested sample was sub-sampled into pre-cleaned borosilicate glass containers for Atomic absorption spectrophotometer

2.3. Fatty acid determination

50mg of the extracted fat content of the sample was saponified for five minutes at 950C with 3.4ml of the 0.5M KOH in dry methanol. The mixture was neutralized by using 0.7M HCl. 3ml of the 14% boron triflouride in methanol was added. The mixture was heated for 5 minutes at the temperature of 90^{0C} to achieve complete methylation process. The fatty acid methyl esters were thrice extracted from the mixture with redistilled n-hexane. The content was concentrated to 1ml for gas chromatography analysis and 1µl was injected into the injection port of gas chromatography.

2.4. Amino acid extraction

The sample of 10.0g was (dried and pulverized sample was made to be free of water by ensuring constant weight for a period of time in the laboratory) weighed into the 250ml conical flask capacity. The sample was deffated by extracting the fat content of the sample with 30ml of the petroleum spirit three times with soxhlet that was equipped with thimble. The sample was hydrolyzed three times for complete hydrolysis. Then the amino acid content of the sample was recovered by extracting with 30ml of the dichloro methane three times before concentrating to 1.0ml. The concentrated extract was derivatised for volatility that is suitable for gas chromatography (AOAC, 1990).

2.5. Vitamin determination

The sample was made to attain the laboratory atmospheric condition on the bench after removing the samples from the storage chamber at less than or equal to 4^{0C}. The sample was pressed and completely homogenized in the mortar carefully with pestle to avoid forming balls.0.10g of the sample was weighed into the 10ml beaker capacity. The sample was extracted in the container by using modified AOAC (1990) method. After the extraction, the extract was concentrated to 1.0ml for the chromatographic analysis.

3. Results

The result of proximate analyses of the Senecio biafrae leaves is shown in Table 1 with 15.26±2.01% protein, it has carbohydrate is the highest percentage of 46.92±2.01with fat of 5.14 ±0.01 as the least. Table 2 shows the composition of soluble and insoluble dietary fiber present in the leave. Also, Table 3 shows the micro and macro minerals present in the sample with potassium having the highest concentration of 536.39 ±0.03mg/100g while aluminum as the least value of 0.004±0.10mg/100g. In addition, Table 4 shows the fatty acids composition of the leave with linolenic acid having the highest value while caprylic acid, margaric acid and erucic acid having the least values. Moreover, the amino acid composition of the leaves is shows in Table 5 with glutamate having the highest value of 13.94±0.02g/100g of protein and cystine having the least value of 1.34±0.01g/100g of protein. Furthermore, the vitamins composition is shown in Table 6 with vitamin C having highest value.

4. Discussion

The proximate composition of Senecio biafrae leaves (Table 1) indicates that it has high protein content, which is highly comparable to other rich foods such as cowpeas, melon, pumpkin, chick beans and lima beans (Balogun and Olatidoye, 2012; Anonymous, 1972). Therefore, the leaves can serve as a better source of protein couple with its high levels of indispensable (essential) amino acids (Table 5), their basic function as a nutrient is to supply adequate amount of required amino acids. Protein deficiency causes growth retardation, muscle wasting, oedema, abnormal swelling of the belly etc (Murray et al., 2000). The crude fibre content of the Senecio biafrae leaves (couple with its soluble dietary fiber as shown in Table 2) was higher than those reported in Ocimum gratissimum leaves, almond nut (7.23 ±0.05%) and legumes (5-6%) (Aremu et al., 2006; Anonymous, 1972; Idris et al., 2011). Crude fibre plays an important role in the maintenance of internal distention for a normal peristaltic movement of the intestinal tract (Balogun and Olatidoye, 2012). It also involves in preventing colon cancer and constipation (Muhammad and Ajiboye, 2010; Ahmed, 1972; Bingham et al., 2003; Park et al., 2005). Furthermore, dietary fibre decreases the absorption of cholesterol from the gut in addition to delaying the digestion and conversion of starch to simple sugars, which is an important factor in the management of diabetes. Dietary fibre also functions in the protection against cardiovascular disease, colorectal cancer and obesity (Eleazu and Okafor, 2012). The carbohydrate content of the seed if digestible can serve as a source of energy. The lower lipid content of Senecio biafrae leaves would probably makes it useful ingredient for both poultry and livestock. This is because high fat content in the feed ingredients would cause difficulty in mixing the feed and could also predispose such feed to oxidative rancidity (Muhammad and Ajiboye, 2010; Atteh, 2002). The moisture content of the dried leaves indicates that it can be stored for long period without spoilage. In addition, the ash content gives an indication of the presence of inorganic elements (Table 3) in the samples.

Table 1
Proximate composition of Senecio biafrae leaves (%).

Parameters	Composition
Crude Protein	15.26±2.01
Crude Fiber	17.78±0.13
Ash	8.72±0.05
Moisture content	6.44±0.09
Fat	5.14 ±0.01
Carbohydrate (by difference)	46.92±2.01

Each value is a mean of three determinations ± SEM.

Table 2
Fiber fraction composition of Senecio biafrae.

Fiber	Amount (%)
Soluble Dietary fiber	13.95±0.02
Insoluble fiber	3.83 ±0.01

Each value is mean of three determination ± SEM.

Table 3
Mineral content of Senecio biafrae leaves (mg/100g).

Minerals	Amount
Iron	4.16 ± 0.01
Copper	0.53 ± 0.02
Cobalt	0.08 ± 0.01
Zinc	3.63 ±0.01
Calcium	242.09 ±0.02
Magnesium	392.27±0.03
Potassium	536.39 ±0.03
Sodium	14.48 ±0.01
Aluminum	0.004±0.10
Selenium	0.013±0.02

Each value is mean of three determination ± SEM.

Table 4
Fatty acid composition of Senecio biafrae leaves (%).

Fatty acids	Amount
Caprylic acid	0.01 ±0.02
Capric acid	0.02 ±0.04
Lauric acid	0.02 ±0.01
Myristic acid	0.01 ±0.01
Palmitic acid	23.84 ±0.03
Palmitoleic acid	1.87 ±0.02
Margaric acid	0.01 ±0.02
Stearic acid	3.69 ±0.02
Oleic acid	5.77 ±0.02
Linoleic acid	25.43 ±0.03
Linolenic acid	38.52±0.01
Arachidic acid	0.50±0.01
Arachidonic acid	0.03 ±0.02
Behenic acid	0.37 ±0.02
Erucic acid	0.01±0.01
Lignoceric acid	0.02±0.01

Each value is a mean of three determination ±SEM.

Table 5
Amino acids composition of Senecio biafrae leaves (mg/100protein).

Amino acids	Senecio biafrae leaves	FAO/WHO (1990)
Glycine	4.60 ±0.01	2.2
Alanine	5.63 ±0.01	6.1
Serine	3.53±0.02	7.7
Proline	3.99 ±0.01	10.7
Valine	5.77 ± 0.02	5.0
Threonine	4.63±0.01	3.4
Isoleucine	5.28±0.02	2.8
Leucine	7.55 ±0.01	6.6
Aspartate	9.00±0.02	7.7
Lysine	6.39±0.01	5.8
Methionine	1.65±0.01	2.5
Glutamate	13.94±0.01	14.7
Phenylalanine	4.80 ±0.01	6.30
Histidine	2.01±0.02	2.5
Arginine	5.38±0.01	5.2
Tyrosine	3.77±0.01	1.10
Tryptophan	1.45±0.01	1.2
Cystine	1.34±0.02	3.0

Each value is a mean of three determination ±SEM.

The mineral content of Senecio biafrae in mg/100g is shown in Table 3. Micro and macro minerals serve as cofactors for many physiologic and metabolic functions (Murray et al., 2000). The levels of the minerals studied were above those reported in Velvet beans seeds (Balogun and Olatidoye, 2012). Magnesium plays an important role in activating many enzymes systems and in maintaining electrical potential in nerves (Balogun and Olatidoye, 2012; Murray et al., 2000). Also, magnesium, manganese and phosphorous are very important minerals in bone and teeth development, iron is very crucial in haemoglobin and cytochromes, copper plays a crucial role in iron absorption (Murray et al., 2000). In addition, presence of antioxidant minerals like copper, manganese and iron indicates that the sample will be a good source of antioxidants with protection of the human body against oxidative damage of biological membrane due to the presence of free radicals (Hassan and AbdEl-Razak, 2012).

The values of proximate and mineral analyses of Senecio biafrae leaves in the present study were not in accordance with Gbadamosi et al (2012). The proximate and minerals analyses observed in this study were also higher than those reported in Kale (Brassica oleraceae) (Emebu and Anyika, 2011).

Table 6
Vitamins composition of Senecio biafrae leaves (mg/100g).

Vitamins	**Amount**
Vitamin A	0.043±1.20
Vitamin B1	0.084±2.10
Vitamin B2	3.69±0.13
Vitamin B3	0.38±0.01
Vitamin B4	0.0008±0.02
Vitamin B5	3.85±0.01
Vitamin B6	0.05±0.1
Vitamin B9	0.41±0.01
Vitamin C	80.81±2.20
Vitamin E	1.39±1.50
Vitamin K	1.90±1.34

Each value is a mean of three determination ±SEM.

In addition, the fatty acid compositions of Senecio biafrae leaves are shown in Table 4. The present of caprylic acid in the leaves gives an indication that the samples can be useful in the commercially production of esters used in perfume and in the manufacture of dyes. This is also used in the treatment of some bacterial infections; due to its relatively short chain length, it has no difficulty in penetrating fatty cell wall membranes (Nair et al., 2005). The present of decanoic acid or capric acid in the Senecio biafrae leaves makes it useful in the manufacture of esters for artificial fruit flavors and perfumes. It is also used in the industrial manufacture of perfumes, lubricants, greases, rubber, dyes, plastics, food additives and pharmaceuticals (David et al., 2006). Lauric acid is the main acid in coconut and palm kernel oils, and is believed to have antimicrobial properties (Hoffman et al., 2001; Outtar et al., 2000; Eleazu and Okafor, 2012). It is also found in human milk (5.8% of total fat), cow milk (2.2%), and goat milk (4.5%), this fatty acid can undergo β-oxidation to produce energy and also be stored in adipose tissues (Nelson and Cox, 2005). Myristic acid is a common saturated fatty acid used in cosmetic. Palmitic acid is one of the most common saturated fatty acids found in animals and plants tissues. This acid is the first fatty acid produced during fatty acid synthesis and from which longer fatty acids can be synthesized (Murray et al., 2000; Muhammad and Ajiboye, 2010). Palmitoleic acid which is an omega-7 monounsaturated fatty acid, is a common constituent of the glycerides in the human adipose tissue. Although, it is synthesize from palmitic acid by the action of the enzyme delta-9 desaturase. It plays an important role in increasing insulin sensitivity by suppressing inflammation, as well as inhibiting the destruction of insulin-secreting pancreatic beta cells, which make it useful for a diabetic patient (especially for type 2 diabetes mellitus). Also, the present of stearic acid in Senecio biafrae leaves make it useful ingredient in dietary supplements (Woottkikanokkhan and Tunjougnawin, 2002; Zhi-Hong et al., 2011). Oleic acid is a fatty acid that occurs naturally in various animals and vegetable and oils. It is a monounsaturated fat, associated with decreased in low-density lipoprotein (LDL) cholesterol, and possibly increased in high-density lipoprotein (HDL) cholesterol (Thomas, 2000). Linoleic acid and linolenic acid are the most essential unsaturated omega- 6 fatty acid, is a polyunsaturated fatty acid used in the biosynthesis of arachidonic acid (AA) and thus some prostaglandins (Nelson and Cox, 2005). They are required for the growth and cell maintenance. Behenic acid (docosanoic acid) found in the sample is a normal carboxylic acid while the present of eruic acid which is a monounsaturated omega-9 fatty acid make the sample useful as a precursor in bio-diesel fuel production (David et al., 2006).

The amino acid profiles of Senecio biafrae leaves are shown in Table 5. Eighteen amino acids were observed; out of which ten were indispensable (lysine, histidine, arginine, threonine, valine, methionine, isoleucine, leucine, tryptophan and phenylalanine) and most are within FAO/ WHO (1990) reference values for daily intake. These amino acids serve as raw materials for the synthesis of many other cellular products, including hormones, enzymes and pigments. In addition, several of these amino acids are key intermediates in cellular metabolism (Murray et al., 2000). The present study indicates that Senecio biafrae leaves can serve as a source of indispensable amino acids for consumers. Moreover, the present of antioxidant vitamins such as Vitamins A, C and E which are free radicals scavengers, makes them useful in the management of diabetes mellitus. They also serve as immune system booster (Sarubin and Thomson, 2007).

5. Conclusion

The results of this study demonstrate the potentials of Senecio biafrae leaves as a rich source of essential nutrients required in the diets of both man and livestock animals. Also, as a useful supplement in the management of degenerative diseases due to generation of free radicals.

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