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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Nutritional Quality of *Crassocephalum crepidioides* and *Senecio biafrae*

F.A.S. Dairo[1] and I.G. Adanlawo[2]
[1]Department of Animal Production and Health Sciences, University of Ado-Ekiti, Nigeria
[2]Department of Biochemistry, University of Ado-Ekiti, Nigeria

Abstract: The nutritional potentials of two green leafy vegetables namely, *Crassocephalum crepidioides* (CC) and *Senecio biafrae* (SB) were evaluated through their proximate composition, mineral and amino acid profile. *Crassocephalum crepidiodies* contained 27.17±0.51% crude protein (CP) while that of *Senecio biafrae* was 28.93±0.68% but were not significantly different ($P \geq 0.05$). The crude fibre content for SB was 7.26±0.22% while that of CC was 8.13±0.06%. The ash content for SB was 16.30±0.21% and 17.31±0.02% for CC. The nitrogen free extract (NFE) for SB was 20.81±1.36% while CC recorded a value of 19.03±0.56%. The organic matter (OM) for SB was 83.70±0.24% and CC had 82.69±0.02%. The mean values of the CP, ash, NFE and OM were not significantly different ($P \geq 0.05$). Iron (Fe) in CC was 0.056±0.006% and 0.029±9.60 x 10^{-4}% These values were not significantly different ($P \geq 0.05$). The mean values for manganese (Mn), sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca) in CC and SB were all significantly different ($P \leq 0.05$). Among all the minerals evaluated, K had the highest value of 0.07±2.0 x 10^{-4} % in CC while it is 0.04±6.0 x 10^{-3} % in SB. The amino acids values in CC ranged from 0.54±0.02 mg/g in threonine to 4.26±0.029 mg/g in tyrosine. In SB isoleucine had the lowest value of 0.51±7.37 x 10^{-4} mg/g while tyrosine recorded the highest, 3.69±0.07 mg/g. Valine, isoleucine and phenylalanine values in the two vegetables differ significantly ($P \leq 0.05$). The total amino acids (TAA) in CC was 19.01±0.08 mg/g and 17.41±0.081mg/g in SB while the total non-essential amino acids (TNEAA) was 11.23±0.06 mg/g and 9.89±0.02 mg/g in the two vegetables respectively which are also significantly different ($P \leq 0.05$). The percent TEAA and percent TEAA with histidine are also significantly different ($P \leq 0.05$). The study indicates that *Crassocephalum crepidioides* and *Senecio biafrae* are good sources of protein in the nutrition of both human and animal.

Key words: Proximate, mineral, amino acid, *Crassocephalum crepidioides, Senecio biafrae*

Introduction

Green leafy vegetables are one of the sources of nutrients for growth in man and animal. The roots and the leaves are also popular potherbs in many parts of the world. They constitute an indispensable part of human diets generally in most part of Africa. 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.*, 1989). Even though there are no recent statistics on vegetable consumption, the abundance in Nigerian markets is a pointer to their use in human diets. *Crassocephalum crepidioides* (locally called "Ebolo") and *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). The high edible mucilaginous fibre, leaves and stem are used to treat indigestion or as laxative and as purgative (Fowomola and Akindahunsi, 2005). With all these qualities, little is known as regards the quality of the amino acid content of most leafy vegetables except recently where information are provided on some for their nutritional importance. There had been reports on the characterization of cassava leaves as food and its amino acid composition (Lancaster and Brooks, 1983; Aletor and Adeogun, 1995; Fasuyi, 2005). Similarly, Ladeji *et al.* (1995) and Fasuyi (2006) both reported the nutritional significance of the amino acid profile of *Telferia occidentalis* while the latter worked further on the proximate characterization, the amino acid profile and the functional properties of *Talinum triangulare* and *Amaranthus cruentus*. There exist in the various ecological zones vegetables that are of natural endowment and of tremendous use as human and animal foods; especially in the present dispensation where vegetable protein sources in animal feeds are becoming increasingly expensive as a result of competition for use as human food. This study therefore was carried out to provide further information on the amino acid profile of some of the Nigerian vegetables of which *crassocephalum crepidioides* and *Senecio biafrae* belong.

Materials and Methods

The two edible vegetables *Crassocephalum crepidioides* and *Senecio biafrae* were obtained from "Oja- Oba" market in Ado-Ekiti, in Ekiti State of Nigeria

Table 1: Proximate composition of *Crassocephalum crepidioides* and *Senecio biafrae*

Parameters (%DM)	Mean Value *Crassocephalum crepidioides*	Mean Value *Senecio biafrae*	Standard Error	Coefficient of Variation	T Test | t | ($P \leq 0.05$)
Dry Matter	85.08±0.19	87.5±0.35	0.20	0.39	0.04^{S}
Crude Protein	27.17±0.51	28.93±0.68	0.39	2.35	19.38^{NS}
Crude Fibre	8.13±0.06	7.26±0.22	0.13	2.98	0.26^{NS}
Ether Extract	12.45±0.02	14.21±0.09	0.05	0.63	0.01^{S}
Ash	17.31±0.02	16.30±0.21	0.12	1.26	0.10^{NS}
NFE	19.03±0.56	20.81±1.36	0.78	6.52	10.33^{NS}
Organic Matter	82.69±0.02	83.70±0.21	0.11	0.25	0.10^{NS}
Metabolizable Energy (Kcal./g)	2.64±0.03	2.91±0.05	0.0023	1.97	0.02^{S}

located in the rain forest zone on latitude $7^{o}40^{1}$ North of the Equator and longitude $5^{o}15^{1}$ East of the Greenwich Meridian. The samples were bought fresh, kept in a transparent polythene bag and transported to the University of Ado-Ekiti where they were sun dried. The foliage samples were hereafter collected and kept in a well labelled screw-capped sample bottles prior to analysis.

Analysis of the samples: The samples of *Cressocephalum crepidioides* and *Senecio biafrae* were divided into triplicate and the proximate analysis determined to obtain values for the dry matter, crude protein, crude fibre, ether extract, ash, nitrogen free extract and the organic matter as described by AOAC (1995). The mineral content analyzed were iron (Fe), manganese (Mn), sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca). About 2 g of each of the dried samples in a crucible were ashed at 550°C in a Gallenkamp muffle furnace. The ash was later dissolved in 100 ml volumetric flask with de-ionized water. 10 ml of concentrated hydrochloric acid was added and filtered. The filterate was made up to 50 ml with 0.1M HCl. Fe, Mn, Mg and Ca values were determined using Atomic Absorption Spectrophotometer (Perkin-Elmer model 403, Norwalk CT, USA). Sodium and potassium were determined by using a flame photometer (model 405, Corning UK). Sodium chloride and potassium chloride were used to prepare the standards.

The amino acid profiles for the samples were determined by using a laboratory blender to blend the dried samples. They were hereafter hydrolyzed at 150°C for about 90 minutes and the solution used for the determination by the modification of Waters 'Pictotag' system as described by Bidlingmeyer *et al.* (1984) and Gardner *et al.* (1991). The amino acid score was calculated as a ratio of the mg. of amino acid per g of test diet to the mg. of amino acid per g protein in reference pattern as described by Crampton and Harris (1969) and WHO (1973). The metabolizable energy of the samples was calculated using the Pauzenga (1985) prediction equation.

Statistical analysis: All the triplicate data collected for each of the samples were subjected to statistical evaluation using the SAS (1987) computer soft ware package version six for t- test among the mean values, standard deviation, standard error and the coefficient of variation (CV).

Results and Discussion

The proximate composition of *Crassocephalum crepidioides* and *Senecio biafrae* is presented in Table 1. The dry matter, the ether extract and the metabolizable energy content of *Senecio biafrae* were significantly higher ($P \leq 0.05$) than that of *Crassosephalum crepidioides* with a coefficient of variation (CV) 0.39% and 0.63% respectively. Though the recorded values did not differ significantly ($P \geq 0.05$), the crude protein, fibre, ash, nitrogen free extracts (NFE) and the organic matter (OM) were all similar. The entire mineral element evaluated except Fe differ significantly ($P \leq 0.05$) among the mean values (Table 2). The macro minerals namely Ca, Mg, K, Na and Mn were all significantly higher in *Crassocephalum crepidioides* than *Senecio biafrae*. The mineral composition of the two vegetables revealed their Fe content to be higher than the other minerals analyzed. The amino acid composition of the two vegetables is presented in Table 3. Proline, isoleucine and phenylalanine content of *Crassocephalum crepidioides* were significantly higher ($P \leq 0.05$) than the values recorded for *Senecio biafrae*. The total amino acids (TAA), total non-essential amino acids (TNEAA), total essential amino acids with histidine (TEAAH), percent total essential amino acids with histidine (%TEAAH) and percent total non-essential amino acids (%TNEAA) all differ significantly ($P \leq 0.05$) with *Crassocephalum crepidioides* having the higher values.

The dry matter content of the samples of the two vegetables evaluated in this study was higher than those reported by Oguntona (1988). This is because sun dried samples were used for the study. Fresh vegetables are generally characterized by high moisture hence the low dry matter content. However, the moisture content of dried vegetable leaves varies depending on the prevailing local environment and length of storage.

The crude protein content of the two vegetables compared favourably with the values obtained for *Amaranthus cruentus* (Fasuyi, 2006) and *Corchorus*

Table 2: Mineral content of *Crassocephalum crepidioides* and *Senecio biafrae* (%)

Mineral	Mean Value *Crassocephalum crepidioides*	Mean Value *Senecio biafrae*	Standard Error	Coefficient of Variation	T Test |t| ($P \leq 0.05$)
Fe	0.056 ± 0.006	0.029±9.6 x 10^{-4}	5.5 x 10^{-4}	3.29	0.13^{NS}
Mn	7.87 x 10^{-4} ±1.52 x 10^{-5}	3.0 x10^{-4}±9.6 x 10^{-4}	5.77 x 10^{-5}	3.33	0.01^{S}
Na	0.09±0.002	0.005±1.01 x 10^{-5}	5.70 x 10^{-5}	2.0	0.01^{S}
K	0.07±2 x 10^{-4}	0.04±6.0 x 10^{-3}	3.51 x 10^{-4}	1.51	0.01^{S}
Mg	0.04±0.001	0.004±2.0 x 10^{-4}	1.15 x 10^{-4}	4.76	0.01^{S}
Ca	0.067±2.65 x 10^{-4}	0.004±1.0 x 10^{-4}	6.1 x 10^{-5}	2.45	0.01^{S}

Table 3: Amino acid composition of *Crassocephalum crepidioides* and *Senecio biafrae* (mg/g crude protein)

Amino acids	Mean Value *Crassocephalum crepidioides*	Ratio of amino acid in Crassocephalum *crepidioides* to egg /amino acid score (%)	Mean Value *Senecio biafrae*	Ratio of amino acid in *Senecio biafrae* to egg/amino acid score (%)	Standard Error	Coefficient of Variation	T Test |t| ($P \leq 0.05$)
Lysine	0.60±0.007	8.30/91.26	0.61±0.001	8.47/91.53	6.44 x 10^{-4}	0.18	21.73^{NS}
Histidine	0.86±0.034	40.95/59.05	0.70±0.005	33.33/66.67	0.003	0.80	0.13^{NS}
Arginine	1.26±0.023	19.69/80.31	1.31±0.009	20.47/79.53	0.005	0.71	3.04^{NS}
Aspartic acid	0.71±8.5 X 10^{-4}		0.63±0.02		0.009	2.46	0.09^{NS}
Threonine	0.54±0.02	11.02/88.98	0.63±0.04	12.86/87.14	0.023	6.38	2.80^{NS}
Serine	0.61±0.005		0.61±0.004		0.002	0.73	63.50^{NS}
Glutamic acid	0.91±2.65 X 10^{-4}		0.97±0.02		0.01	2.50	0.85^{NS}
Proline	2.33±0.003		1.69±0.02		0.01	1.27	0.01^{NS}
Glysine	0.87±0.018		0.68±0.009		0.005	1.37	62.58^{NS}
Cystine	1.07±0.002	44.58/55.42	0.85±0.004	35.41/64.58	0.002	0.47	0.07^{NS}
Valine	0.55±0.0059	7.95/92.40	0.88±7*10^{-4}	12.05/87.95	4.0 x10^{-4}	0.08	0.01^{S}
Methionine	0.58±1.15 X 10^{-4}	14.15/85.85	0.58±0.004	14.15/85.85	0.002	0.73	28.82^{NS}
Isoleucine	0.91±0.01	11.38/88.63	0.51±7.37 x 10^{-4}	**6.38/93.63	4.25 x 10^{-4}	0.14	0.01^{S}
Leucine	0.62±0.004	**6.74/93.26	0.63±0.002	6.84/93.12	9.2 x10^{-4}	0.25	23.57^{NS}
Tyrosine	4.26±0.29	93.3/5.33	3.69±0.007	80.00/18.00	0.005	0.21	3.30^{NS}
Phenylalanine	1.91±0.001	30.31/69.68	1.65±0.006	26.19/73.81	0.003	0.36	0.01^{S}

S = Significant (P= 0.05): NS = Not Significant (P=0.05). **Limiting amino acid

Table 4: Total amino acid composition of *Crassocephalum crepidioides* and *Senecio biafrae* (%)

*TAA	19.01±0.081	17.41±0.08	0.045	0.45	0.01^{S}
*TNEAA	11.23±0.06	9.89±0.02	0.017	0.29	0.01^{S}
*TEAA	6.99±0.025	6.80±0.06	0.057	0.94	0.04^{NS}
*TEAA + Histidne	7.85±0.02	7.52±0.05	0.028	0.66	0.89^{NS}
%TNEAA	58.74±0.20	56.83±0.09	0.05	0.16	0.01^{S}
%TEAA	36.65±0.27	39.13±0.10	0.06	0.26	0.16^{NS}
% TEAA + Histidine	41.16±0.12	43.17±0.09		0.21	0.01^{S*}

TAA = Total Amino acid. *TNEAA =Total Non-Essential Amino acid. *TEAA = Total Amino acid. S = Significant (P= 0.05) ; NS = Not Significant (P=0.05)

(Oguntona *et al*., 1989), lower than the values reported for cassava leaf protein concentrate (Fasuyi, 2005) but higher than the protein content in its fresh leaves as reported by Oguntona *et al*. (1989) which is a function of the dry matter of the sample. *Crassocephalum crepidioides* and *Senecio biafrae* have crude fibre range of 7.26- 8.13% which is within the tolerable range for both infant and adult (Adeyeye, 1997). They can be good sources of succulent forages for rabbits and other pseudo ruminant animals. The dry matter and organic matter content of the two vegetables range between 85.08 and 87.51%, 82.69 and 83.70% which would be very good for the feeding of herbivores and other ruminants. The macro mineral content is higher in *Crassocephalum crepidioides* than in *Senecio biafrae*. The values obtained in this study are lower than those reported by Aletor and Adeogun (1995) and Oguntona (1998). With the higher dry matter content obtained in this study, the expectation is that the minerals evaluated would have higher concentration in the vegetables as reported by the earlier mentioned workers. However, it is known that the nutrient content of a crop is highly influenced by the soil nutrient or fertility and the type and quality of fertilizer that was applied at the time of cultivation. Nonetheless, the values obtained still follow the trend reported by these workers with Na having the highest value followed by K and Ca. The mineral content of vegetables often inform their use in human diets as purgative and as an agent that aid digestion process because some of them (in their divalent state) function as cofactors to enzymes in most of the nutrient metabolic processes for healthy living (Mackenzie *et al*., 1985; Kim, 1995).

The amino acids profile indicates that *Crassocephalum* *crepidioides* and *Senecio biafrae* are limiting in the essential amino acids. Tyrosine had the highest values among the amino acids in the two vegetable samples. The amino acids content is quite inferior to the values obtained for the legumes such as African yam beans, soybean and many others (Aletor and Adeogun, 1995; Adeyeye, 1997) and some vegetables as reported by Fasuyi (2006) for *Talinum triangulare, Amaranthus cruentus* and *Telfairia occidentalis.* The TAA was significantly higher in *Crassocephalum crepidioides* than *Senecio biafrae* and this trend was followed by the TEAA, TNEAA, percent TNEAA and %TEAA. The total essential amino acid with histidine (TEAAH) was also significantly higher in *Crassocephalum crepidioides* than *Senecio biafrae.* The environmental factors of the soil may also influence the essential amino acid composition. The limiting amino acid in *Crassocephalum crepidioides* is leucine with amino acid score of 6.74 or 93.26% while it is isoleucine in *Senecio biafrae* with a score of 6.38 or 93.12%. The use of these vegetables as food imply that they must be supplemented with other good sources of plant or animal protein for infant and adult feeding in man and farm animals. Since these vegetables grow unhindered under cocoa or kolanut plantation especially in the south west of Nigeria they can be further processed into leaf concentrate protein supplemented with soybean and cereal to enhance the protein and energy content. The calculated metabolizable energy content for *Crassocephalum crepidioides* is 10.58 MJ kg^{-1} while 11.65 MJ kg^{-1} was obtained for *Senecio biafrae* (Table 1). The values obtained are higher than those reported by Oguntona *et al.* (1989) but expectedly lower than those of cereals as a result of the lower dry matter and ether extract content. The total amino acids in *Crassocephalum crepidioides* (19.08±0.081 mg/g) and *Senecio biafrae* (17.41±0.08 mg/g) and the total essential amino acids values (with histidine) of 7.85± 0.02 mg/g and 7.52±0.05 mg/g respectively were lower than the values recorded for cow's milk (490 mg) and that of egg with histidine but no tryptophane (495 mg) (FAO WHO/UNU, 1985; Adeyeye and Afolabi, 2004). The percent TNEAA in the two vegetables were higher than the percent TEAA. This indicate that the vegetables are lower in the essential amino acids hence require supplementation with other rich sources of essential amino acids for effective use as animal or human diets. Traditionally, these vegetables are cooked as local delicacies either as mixture with *Colocynthis citrullis* or dried crayfish or fish that are rich in the essential amino acids. The deficiencies in amino acids composition are hence compensated for through the animal protein sources in this regards.

Conclusively, *Crassocephalum crepidioides* and *Senecio biafrae* are good sources of vegetable protein of which their quality could be enhanced through supplementation.

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