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Proximate and Mineral Analysis of Some Wild Leafy Vegetables Common in Benue State, Middle Belt-Nigeria

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Abstract: The proximate analysis and mineral composition of some commonly grown and consumed leafy vegetables in the middle belt region of Nigeria were studied to determine their nutritional content. They include *Ficus thonningii, Annona senegalensis, Emilia coccinea and Hibiscus sabdariffa*. The proximate analyses revealed the following range of result in the fresh sample; Moisture(62.32 -93.38%),Crude Fat(0.05-0.71%), Crude Fibre (1.30-20.15%), Ash(1.06-2.37%), Crude Protein(0.03-0.33%),Carbohydrate (4.16 -15.12%)and Energy value (17.21 to 67.02 kJ/100g) while that for dried samples were Moisture(11.33-28.58%),Crude Fat(0.57-3.43%), Crude Fibre (10.51-36.86%),Ash(4.70-12.77%), Crude Protein(0.28-1.53%),Carbohydrate (33.11-62.11%) and Energy value(120.57 to 345.7 kJ/100g). There was no significant difference between the nutrient and mineral content of the studied vegetables. The wild vegetables contain appreciable amount of essential nutrient molecules and mineral elements needed for the maintenance of good nutritional status and thus can compete favourably with commonly consumed vegetables.

Keywords: Proximate, Vegetables, Mineral analysis, Composition , Nutrient

1.1 INTRODUCTION

Nigeria is endowed with numerous varieties of useful plants whose fruits, seeds, stems, roots and leaves serve various important roles in medicine and nutrition Adebowale et al (2013). Unfortunately many of such plants have not been put into maximum use except in times of nutritional stress (McBurney et al, 2004). The neglect of these wild food plants has been attributed to the insufficiency of information on their nutritional profile and potential to serve as food security Afolayan & Jimoh (2009).The United Nation Food and Agriculture Organization (UNFAO) have estimated that the number of undernourished people in developing countries was 824 million in 1990-1992. In 2010, the number had climbed to 925 million people. The target set at the 1996 world Food summit was to halve the number of undernourished people by 2015 from their number in 1990-1992 (FAO, 2004). This problem of malnutrition can be reduced by encouraging the use of wild vegetables, as they remain the cheapest source of proteins, minerals and vitamins in the diet of many people (Grivetti and Ogle, 2000; Lyimo et al, 2003). Earlier research on wild mucilaginous vegetable by Ubwa *et al* (2014) in the same study area had reviewed appreciable amounts of food nutrients in these vegetables and hence their food value is further reiterated.

Ficus thonningii blume is an ever green tree, 6 to 21m tall with a rounded to spreading and dense crown sometimes epiphytic. Its leaves are simply flossy, dark green, thin and papery or slightly leathery, margin smooth, elliptic or obovate, sometimes rather elongated or slightly oblanceolate, grouped at end of twinges (Hines and Karlyneckman, 1993; Gidado and Gwargwor, 2013). *Ficus thonnigii* is widely distributed in upland forest, open grassland, riverine and rocky areas, it's also found in the savannah Davis (1989). It is an eatable plant that is well consumed among the Tiv speaking people of Benue state, Nigeria. It's also believed to have a medicinal value of curing yellow fever.

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Annona Senegalesis is found in tropical rain forest as well as the savannah region of Nigeria and other West African countries. It is sometimes described as a small tree or shrubs since it is about 8feet high Keay et al. (1964). The leaves are sometimes used as vegetable for making soup. The leaves, stem, bark and root of the plant can also be used for medicinal purposes. It has been reported for treatment of ailments such as cancer, cough and for dressing wound (Abdullahi et al. 2003)

Emilia coccinea belongs to the family Compositae (Asteraceae). The members of this family are largely woody herbs or shrubs, a few trees and climbing herbs Olorede, (1984). *E coccinea* is also known as "tassel flower". It is an erect bushy herb of up to 120 cm in height. *E. coccinea* is an ubiquitous weed of waste place and fallow land. The antimicrobial properties of *Emilia coccinea* and its use for therapeutic treatment have been investigated by a number of researchers worldwide. According to earlier reports (Odugbemi, 2006). *Emilia coccinea* has been reported for its medicinal properties for the treatment of syphilis, hernia, gonorrhoea, ulcer, 'craw-craw', abscesses of the breast, ringworm, lice, measles, cough etc. In Nigeria, the leaves are eaten cooked as salad or spinach and the fresh juice of the leaves is a remedy for sore eyes (Sofowora, 1982).

Hibiscus Sabdariffa is a shrub belonging to the family of Malvaceae and is thought to be native to Asia or Tropical Africa Gautam (2004). It is a hardy herbaceous shrub that grows well in most soils that are well drained. The plant is about 3.5 m tall and has a deep penetrating taproot. It has a smooth or nearly smooth, cylindrical, typically dark green to red stems. Leaves are alternate, 7.5-12.5 cm long, green with reddish veins and long or short petioles. Leaves of young seedlings and upper leaves of older plants are simple; lower leaves are deeply 3 to 5 or even 7 lobed and the margins are toothed (Julia, 1987). It is commonly grown in the middle belt and North Eastern regions of Nigeria (Akanya et al. 1997).

The neglect of some of these vegetables coupled with the increased reduction in their consumption prompted this research. The study was aimed at providing the nutritional profile of some of these indigenous vegetables that are found available in Benue state, middle belt region in Nigeria as wild plants.

2.1 MATERIALS AND METHODS

2.1.1 Sample Collection and Identification

The leaves of the vegetables (*F. Thonningii, A. Senegalesis, E. Coccinea, H. Sabdariffa*) were collected from the wild around Makurdi, Benue State, Nigeria. The leaves were identified and authenticated by a Taxonomist in the Department of Biological Sciences, Benue State University Makurdi.

2.1.2 Sample Preparation

The collected plant leaves were cleaned and separated into two portions. The first portion was sliced with a knife into smaller pieces and kept in the fridge for fresh sample analysis. The second portion was spread on an already cleaned laboratory bench for two weeks in the Chemistry laboratory of Benue State University, Makurdi. The dried leaves were later pounded into powder with laboratory mortar and pestle. A portion of the powdered sample was then kept for determination of the various parameters.

2.1.3 Experimental Analysis

The proximate analysis (Protein, fats, fibre, ash, moisture and carbohydrates) of the fresh and dry samples of the plant leaves were determined by the method described by AOAC (2000) and the ASEAN Manual of Food Analysis (Pwwastein et al. 2011). The total crude protein was determined by Kjeldahl method. The nitrogen value was converted to protein by multiplying a factor of 6.25.The crude fat content was determined using soxhlet extraction method. The moisture content of the sample was determined by drying the sample to a constant weight at 105^{o}C in an air-oven. The ash and crude fibre were determined using weight loss method. The carbohydrate content was determined using weight difference method. The energy values of the vegetables were calculated using the conversion factor provided by Food and Agricultural Organization (FAO, 2004b). The mineral content of the fresh and dried samples were determined using PG 990 Atomic Absorption Spectrophotometer.

3.1 RESULTS AND DISCUSSION

The results for proximate composition and mineral content of the vegetables studied are presented in Tables 1 and 2 below respectively.

Table 1. Proximate composition of the studied vegetables

Parameter	***Ficus thonningii***		***Annona senegalesis***		***Emilia coccinea***		***Hibiscus sabdariffa***	
	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried
Moisture	83.38±0.40	13.18±0.26	62.36±3.24	11.78±0.14	93.38±0.67	28.58±0.13	86.73±0.64	11.33±0.16
Crude Fat	0.71±0.20	2.57±0.16	0.58 ±037	2.94±0.44	0.05±0.52	0.57±0.49	0.71±0.16	3.43±0.30
Crude Fibre	2.31±1.26	36.86±0.99	20.15±1.71	35.21±3.60	1.30±1.33	10.51±0.00	1.47±0.18	12.48±0.11
Ash content	2.37±0.69	12.77±0.01	1.46 ±0.16	4.70±0.00	1.06±0.49	7.06±0.01	1.49±0.28	9.13±0.36
Crude Protein	0.33±0.04	1.53±0.00	0.33 ±0.05	0.85± 0.14	0.03±0.00	0.28±0.39	0.25±0.05	1.53±0.01
Carbohydrate content	10.90±1.06	33.11±0.81	15.12±4.69	44.60±3.17	4.16±0.21	53.01±2.01	9.36±0.43	62.11±0.72
Energy value (cal)	51.31	161.65	67.02	345.70	17.21	218.29	44.83	285.43

*Mean±S.D of triplicate determinations

Table 2. Mineral content of the studied vegetables (mg/100g)

Parameter	***Ficus thonningii***		***Annona senegalesis***		***Emilia coccinea***		***Hibiscus sabdariffa***	
	Fresh	Dried	Fresh	Dried	Fresh	Dried	Fresh	Dried
Sodium	2.36±0.001	ND	ND	ND	13.13±0.004	11.63±0.007	ND	ND
Potassium	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	20.93±0.002	186.89±0.005	64.11±0.002	191.50±0.004	13.10±0.002	187.13±0.001	37.74±0.001	257.22±0.001
Copper	0.33±0.004	1.40±0.001	0.09±0.000	1.05±0.001	0.48±0.001	1.91±0.001	0.27±0.001	0.92±0.001
Lead	ND	ND	0.17±0.001	3.65±0.003	0.86±0.00	3.64±0.003	0.02±0.002	2.00±0.004
Nickel	1.53±0.003	27.25±0.003	1.11±0.001	2.59±0.004	0.64±0.006	1.67±0.003	1.88±0.001	0.98±0.007
Zinc	0.89±0.00	33.9±0.003	0.80±0.001	1.62±0.002	1.31±0.001	5.13±0.002	0.76±0.002	3.93±0.001
Manganese	ND	46.45±0.001	6.72±0.003	16.23±0.01	2.63±0.003	23.87±0.005	17.37±0.00	242.86±0.002

*Mean±S.D of triplicate determinations

The moisture content of the fresh samples ranged from 62.32 to 93.38% with the least in *A.senegalesis* and the highest in *E.coccinea*. These fresh vegetables have high moisture contents. Foods with moisture content of 50-95 percent are referred to as high moisture foods (Desrosier et al. 1997). The moisture content in the dried samples ranged from 11.33 to 28.58% with the least and highest in *H.sabdariffa* and *E.coccinea* respectively. The high moisture content for the fresh vegetables are in conformity with the data released by the US Department of Agriculture (USDA) standard which gives a range of 72.4 – 95.2 % moisture content for fresh fruits and vegetables with exception of *A. senegalensis* (USDA, 2009) although all the results are within the 60 to 83 g/100g recommended by Food and Agricultural Organization (FAO, 1968) for fresh vegetables and fruits.The moisture content in the dried samples are also high compared to the 8.7% reported by Pearson (1976) and 7.7% reported by Tijjani et al. (2013) in *F. Thonningi* and *A. Senegalesis* respectively. The high moisture content of these vegetables will however render them susceptible to microbial degradation and subsequently high perishability (Yusuf and Muritala, 2013).

The fibre content of the fresh sample ranged from 1.30 to 20.15% with the least in *E. coccinea* and the highest in *A. senegalesis*. The crude fibre of the dried samples ranges from 10.51 to 36.86 %. The crude fibre content of all the samples is above the 8 g/300 g recommended by WHO/EU (2000) for vegetables. The high values of the crude fibre are in agreement with previous research for similar leafy vegetables (Ekpo 2007; Yisa et al. 2010) .The ash content of the fresh sample ranged from 1.06 to 2.37 % with the lowest in *E. coccinea* and the highest in *F. thonningi*. In the dried sample, the ash content is in the range of 4.70 to 12.77 %. The least and highest values were found in *A. senegalensis* and *F. thonningi*

respectively. All the fresh samples had ash content that is within USDA standard of 0.2 – 1.9 % reported by USDA (2009) for fresh vegetables except *F. thonningii* which had a higher ash content of 2.37 % but was still within the range of 0.1 – 4.4 percent found in most fresh vegetables (Kirk and Sawyer, 1991). The high ashes content of *F. thonningiis* an indication of its high mineral content. All the vegetables can be good source of minerals because of their high ash content

The crude fat content of the fresh sample ranged from 0.05 to 0.71 % with the least in *E.coccinea* and the highest in *F. thonningi* and *H. sabdariffa*. The range of 0.57 to 3.43 % was found in the dried sample with *E. coccinea* having the least value while *H. sabdariffa* has the highest amount of crude fat. The results are in conformity with similar studies on leafy vegetables with range of 0.5- 7.62 % (Hanif and Musdasar, 2006; Sobowale and Olatidoye, 2011). The fat content of all the fresh samples of the vegetables studied are below the 2g/ 300g reported by WHO/EU (2000) for vegetables while those of the dried samples are all above the standard except that of *E. Coccinea*. The consumption of these vegetables is healthy for the body since excess fat in the body causes cardiovascular disorders (Sobowale and Olatidoye, 2011).

The crude protein content of the fresh samples was in the range of 0.03 to 0.33 %. The dried samples have a range of 0.28 to 1.53 %. The least amount of crude protein in both the fresh and dried samples was found in *E.coccinea* while the highest for both is found in *F.thonningi*. The results for both fresh and dried samples are in conformity with that of the USDA (2009) which gives a range of 0.3- 2.0 % for protein in vegetables. The energy values for the fresh samples were in the range of 17.21 to 67.02 kJ/100g while that of the dried samples were in the range of 120.57 to 345.7 kJ/100g. *A.Senegalensis* has the highest energy content while *E.Coccinea* has the least. It can be seen that these vegetables generally have low energy values and therefore can be used for weight loss. The carbohydrate content of the fresh samples was in the range of 4.16 -15.12 % while that of dried samples was 33.11-62.11 %. Complex carbohydrates which are found in vegetables are preferred by the body since they slow the conversion to simple sugars like glucose and decrease insulin level which will subsequently help in burning fats (Mercola, 2014).

It very eminent from table 2 that, dry vegetable samples had levels of minerals higher than their fresh counterparts. This could be attributed to the concentration of the minerals on drying. Magnesium recorded the highest levels in all the samples ranging from 13.10 to 64.11 mg/100g and 186.89 to 257.22 mg/100g for fresh and dried samples respectively. These levels of Mg are however below the National Agency for and Drug Administration and Control (NAFDAC, 2010) recommended daily intake (RDI) of 375 mg/100g. The levels of Manganese in the samples (2.63 to 242.86 mg/100g) were found to be above the RDI of 2 mg/100g recommended by NAFDAC except in fresh sample of *F.thonningi* where it was found below detection limit. In addition, the presence of copper in the dried samples of *F.thonningi, A.senegalensis and E.coccinea* were aboive the RDI of 1 mg/100g. Other trace elements including sodium, Nickel and Zinc were also detected in the samples. Similar levels of these minerals had been reported in our earlier studies on wild mucilaginous vegetables in the study area (Ubwa et al. 2014).

Analysis of variance (ANOVA) was carried out based on multiple statuses of the variables to be compared. The result of the ANOVA test for the equality of means between the different samples of fresh vegetables under which various food nutrients was recorded showed a probability value of 0.9808 ($p>0.05$) indicating no significant difference between the nutrient content obtained from the different samples of fresh vegetables. A similar trend was observed for dried vegetable samples for the same category of food nutrients with a probability value of 0.9581 ($p>0.05$) indicating the absence of significant difference for nutrient content of the various dried vegetable samples.

Statistical analysis on the mineral content of fresh vegetables revealed that, there is no significant difference between *F.thonningi, A.senegalesis, E.coccinea and H.sabdariffa*. This is evidenced by the probability value of 0.3892 which is greater than the alpha level of 0.05 (5% level of significance). This similar trend was observed for the mineral content of the dried vegetable samples with p-value of 0.7923 being greater than the alpha level of 0.05 indicative of no significant difference.

4.1 CONCLUSION

This study has revealed that the leaves of *Ficus Thonningii, Annona Senegalensis, Emilia Coccinea and Hibiscus Sabdariffa contain* some appreciable amount of essential nutrient molecules and mineral elements needed for the maintenance of good nutritional status and they compete favourably with commonly consumed vegetables.

COMPETING INTEREST

Authors have declared that no competing interest exist.

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