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Evaluation of mineral composition and proximate analysis of selected wild leafy vegetables in Hong Adamawa state, Nigeria

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Abstract
The proximate analysis and mineral composition of some selected wild and consumed leafy vegetables in Hong Adamawa State of Nigeria were studied to determine their nutritional content using standard method of analysis. The Vegetables include Baobab, Blood plum, Bombax costatum and Ndaha. The results of the mineral composition show the following range Ca (74.612±0.008 - 203.542±2.001mg/kg), Cd (0.001±0.000 - 0.003±0.001mg/kg), Pb (0.001±0.000 - 0.002±0.001mg/kg), Mn (3.440±0.003 - 13.085±0.811mg/kg), Mg (22.831±0.451 - 124.156±2.23mg/kg) and Zn (0.085±0.003 - 3.015±0.031mg/kg). The proximate analyses revealed the following range of result, Ash content (6.00 - 17.00%), Moisture content (4.50 – 6.00%), Crude fibre (1.32 - 5.15%), Crude lipid (2.44 - 11.17%), Crude Protein (27.2 – 36.78%) and Carbohydrate 38 – 47.74%). The wild vegetables contain appreciable amount of essential nutrient and mineral elements needed for the maintenance of good nutritional status and thus can compete favorably with commonly consumed vegetables.

Keywords: proximate, mineral, wild, leafy, food and vegetables

1. Introduction

Vegetables play an important role in human diets because it supplies nutrients and minerals that support the normal functioning of different body systems (Williams, Nuhu and Nachana'a 2020) [40]. Vegetables are good sources of carbohydrates, oil, minerals and vitamins depending on the type and Varity of vegetable consumed (Ihekoronye and Ngoddy, 1985 [19]; Ononugbu, 2002; Duma, Alsina, and Lepse, 2014) [12]. They provide cells with minerals, vitamins, phytonutrients, essential oils and fibber. Vegetables are the edible parts of plant that are consumed wholly or in parts, raw or cooked as part of main dish or salad.

A vegetable includes fungi, roots, tubers, stems, leaves, bulb, flowers, fruits and seeds (Uzo, 1989 [34]; Waegbule, 1989) [38]. Leaf vegetables can form very wide variety of plants with edible leaves. Green leafy vegetables are popularly used for food, being a rich source of Beta-carotene, ascorbic acid, minerals and dietary fibre. Vegetables contain low amounts of calories and fats (Anjorin, Ikokoh and Okolona, 2010 [4]; Banerjee, Datta and Mondal, 2012) [11]. Vegetable oil and fats lower blood lipids thereby reducing the occurrence of disease associated with damage of coronary artery (Ononugbu, 2002).

Leafy vegetables add to the variety of menu and is included among important items of diet in many Nigerian homes (Mephba, Eboh, and Banigo 2007 [22]; Sobukola, Dairo, Odunewu, and. Fafiolu 2007) [12]. They are valuable sources of nutrients especially in rural areas where they contributes substantially to protein, minerals, vitamins, fibres and other nutrients which are usually not enough in daily diets (Mohammed and Sharif, 2011) [24].

Vegetables are valuable in maintaining alkaline reserve of the body. They are valued mainly for their high mineral and vitamin contents as well as carbohydrate. Vegetables also act as buffering agents for acidic substances produced during the digestion process (Onwordi, Ogungbade, and Wusu 2009).

The United Nation Food and Agriculture Organization (UNFAO) have estimated that the number of undernourished people in developing countries was 925 million in 2010. The target set at the 1996 world Food summit was to reduce the number of undernourished people halve by 2020. This can be achieved by encouraging the use of wild vegetables, as they remain the readily available and cheapest source of proteins, minerals and vitamins in the diet of many poor people (Ubwa, Tyohemba, and Qrisstuberg 2015) [33].

Baobab *(Adansonia digitata)* is the most widespread tree species of the genus *Adansonia*, the baobabs, and is native to the African continent. The long-lived pachycauls are typically found in dry, hot savannahs of sub-Saharan Africa, where they dominate the landscape, and reveal the presence of a watercourse from afar (Wickens and Lowe, 2008) [41]. Their growth rate is determined by ground water or rainfall (Hankey, 2004 [17]; Grové, 2011) [15] and their maximum age, which is subject to much conjecture, seems to be in the order of 1,500 years (Woodborne, 2015).

They have traditionally been valued as sources of food, water, health remedies or places of shelter and are steeped in legend and superstition. (Hankey, 2004) [17]. European explorers of old were inclined to carve their names on baobabs, and many are defaced by modern graffiti (Wickens and Lowe, 2008) [41]. Baobab leaves can be eaten as a relish. Young fresh leaves are cooked in a sauce and sometimes are dried and powdered. The powder is sold in many village markets in northen part of Nigeria. The leaves are used in the preparation of a soup termed miyan kuka in Northern Nigeria (Michel, 2015 [23]; Sidibe and Williams; 2002; Heuzé,

Tran, Bastianelli, Archimède, 2013) [18].

Blood plum (*Haematostaphis barteri*) is a wild edible vegetable belonging to the *Anacardiaceae* family. It is a perennial tree crop which normally grows wildly in the forest and usually among savannah. The tree is found wild in Borno, Adamawa and Taraba States of Nigeria, and it is known as Jinin Kafri in Hausa language. The leaves of blood plum are used for seasoning soup in some local government areas of Adamawa and Taraba states as well as animal feed. It is also used in nursing the snake bite victims, therefore, the plant bark is also used in treating liver, gall bladder, spleen disorders and jaundice, whereas the wood is used as firewood. The *H. barteri* fruit has oily seed which is edible (Hankey 2004) [17].

Bombax costatum is a deciduous tree up to 25 m high, in the Sahel hardly over 6 m. Crown structure of young trees storeyed, becoming irregular and sturdy in older trees. Bark thick, grey brown and corky, with typical conical, stout, sharp-pointed spines on the stem and branches. Slash light red-brown Leaves digitately compound, with 5-7 leaflets, 8-15 cm long, on long petioles. Leaflets partly ovate, partly acuminate at both ends, with 8-10 pairs of lateral nerves. Flowers (5-6 cm) long and solitary, deep red, orange or yellow, tulipshaped, on long, glabrous peduncles. Calyx cup-shaped.Fruit a dark brown, ellipsoidal capsule, composed of 5 valves, dehiscent,8-16 cm long and 3-6 cm wide, of variable shape. The valves are furrowed for about one third the distances from the top to the middle (Wickens and Lowe 2008) [41].

Ndaha is a perennial tree plant with leaves spread on the minor branch. The tree is commonly found in Nigeria especially in Hong Adamawa State.

In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acids (Ubwa, Tyohemba, and Qrisstuberg 2015) [33]. Several works reporting proximate and mineral composition and functional properties of various types of edible grown plants in use in developing countries (Ekop, 2007 [14]; Onwordi, Ogungbade and Wusu, 2009 [27]; Ubwa, Tyohemba, and Qrisstuberg 2015) [33]. However, little has been done on the proximate analysis and mineral composition of edible wild leafy vegetables.

Nigeria is endowed with numerous varieties of useful wild plants whose fruits, seeds, stems, roots and leaves serve various important roles in medicine and nutrition (Adebowale, Nwokocha and Agbaje, 2013) [1]. Unfortunately many of such plants have not been put into maximum use (McBurney Griffin and Greenberg, 2004) [21] because of lack of adequate information on their nutritional contents. 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 and Jimoh (2009) [3]. Knowledge on different chemical constituents and nutrient present in these wild vegetables is important for an appropriate choice of products according to the physiological needs (Asaolu, Adefemi, Oyakilome, Ajibulu and Asaolu, 2012 [7]; Duma, Alsina, and Lepse, 2014) [12]. This study was carried out to evaluate the chemical constituents of selected varieties of wild leafy vegetables found in Hong local government area. Also proximate analysis was carried out to determine the nutrient content of the selected vegetables.

2. Materials and Methods

2.1 Plant sample collection and preparation

Four different leafy vegetables were collected from different locations in Hong local government area of Adamawa State. The samples were collected between the months of July and December 2018. The leaves were detached from the stalk. Part of the detached leaves was used for moisture content determination. The remaining leaves were rinsed with deionized water and sun dried for 7 days on a clean paper with constant turning over to avert fungal growth (Onwordi, Ogungbade, and Wusu 2009) [27]. The dried leaves were ground into powder using pestle and mortar. The ground portion was kept in a plastic bottle in a freezer prior analysis.

2.2 Proximate Analysis

Moisture, ash, crude protein, fat content, carbohydrate and crude fibre were determined following the official methods of the association of official analytical chemists (AOAC 2000) [5], while nitrogen was determined by the micro-kjeldahl method (Pearson, 1976) [29] and the percentage of nitrogen was converted to crude protein by multiplying by 6.25. Carbohydrate was determined by difference (Onwordi, Ogungbade, and Wusu 2009) [27]. The results were presented in the form of a percentage of dry weight bases.

2.3 Mineral Analysis

The minerals in the leafy vegetables were analysed using Atomic absorption spectrophotometer (Buck scientific model 200A) from solution obtained when 2.0g of the samples were digested with concentrated nitric acid and concentrated perchloric acid in ratios 5:3, the mixtures were placed on a water bath for three hours at 80ºC. The resultant solution was cooled and filtered into 100ml standard flask and made to mark with distilled water (Asaolu, 1995) [6].

3. Result

The results of the mineral composition of the selected wild vegetables were shown in Table 1, while the results of the proximate analysis were presented in Table 2. Figures 1, 2, 3, 4, 5 and 6 showed the comparison of the ash, moisture content, crude fibre, crude lipid, protein and carbohydrate in all the vegetables respectively.

Table 1: shows the mineral composition of the selected wild vegetables considered in the study

Minerals	Baobab	Blood plum	Bombax costatum	Ndaha
Ca	173.442±4.11	74.612±0.008	102.131±1.0 11	203.542±2.001
Cd	0.002±0.000	0.001±0.000	0.003±0.001	0.001±0.000
Pb	0.001±0.000	0.002±0.001	0.001±0.000	0.002±0.000
Mn	9.812±0.760	3.440±0.003	4.005±0.112	13.085±0.811
Mg	72.812±1.000	28.921±0.032	22.831±0.451	124.156±2.23

Zn	0.085±0.003	0.851±0.005	0.599±0.008	3.015±0.031
Cd	0.002±0.000	0.001±0.000	0.003±0.001	0.001±0.000
Pb	0.001±0.000	0.002±0.001	0.001±0.000	0.002±0.000
Mn	9.812±0.760	3.440±0.003	4.005±0.112	13.085±0.811
Mg	72.812±1.000	28.921±0.032	22.831±0.451	124.156±2.23

Mean ± S.D of triplicate determinations

Table 2: shows the proximate analysis of the selected wild vegetables considered in the study

	Baobab	Blood plum	Bombax costatum	Ndaha
Ash content	8.50	17.00	6.00	13.00
Moisture content	4.50	5.00	6.00	5.50
Crude fibre	1.32	5.15	2.05	3.60
Crude lipid	2.44	7.65	11.17	3.63
Crude protein	35.5	27.2	36.78	27.3
Carbohydrate	47.74	38.0	38.0	46.97

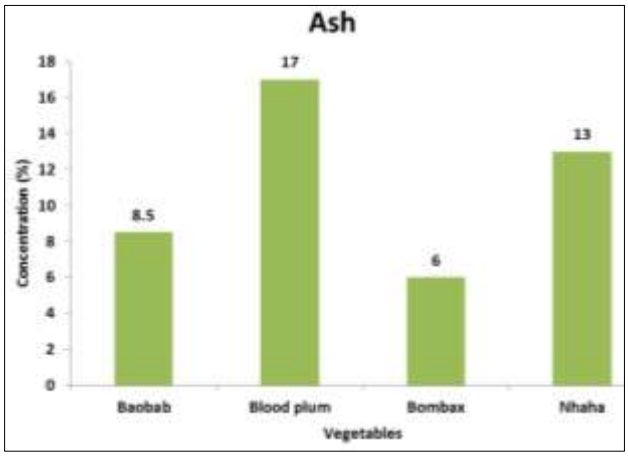

Fig 1: shows the comparison of the Ash content in all the vegetables considered in the study

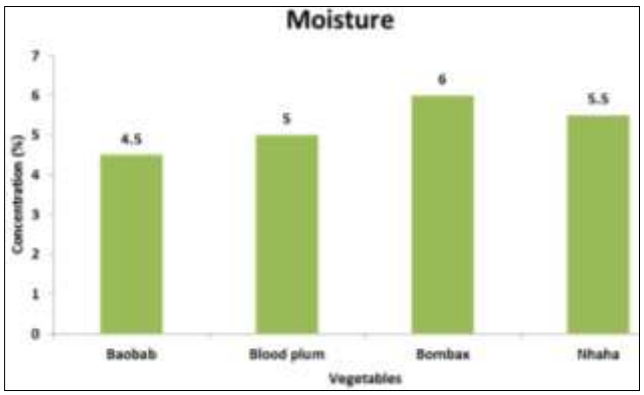

Fig 2: shows the comparison of the Moisture content in all the vegetables considered in the study

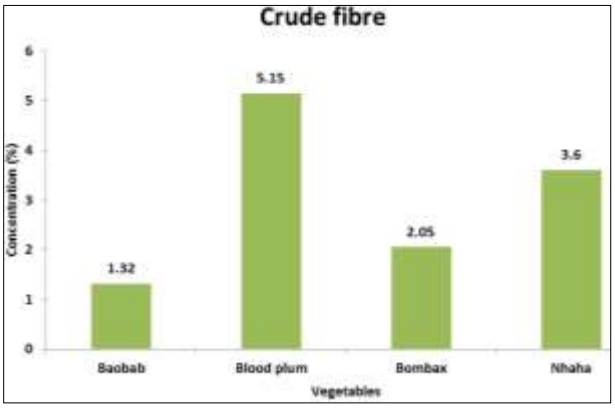

Fig 3: shows the comparison of the Crude fibre in all the vegetables considered in the study

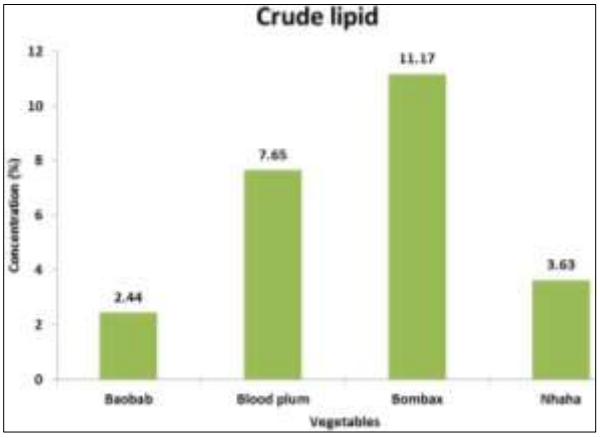

Fig 4: shows the comparison of the Crude lipid in all the vegetables considered in the study

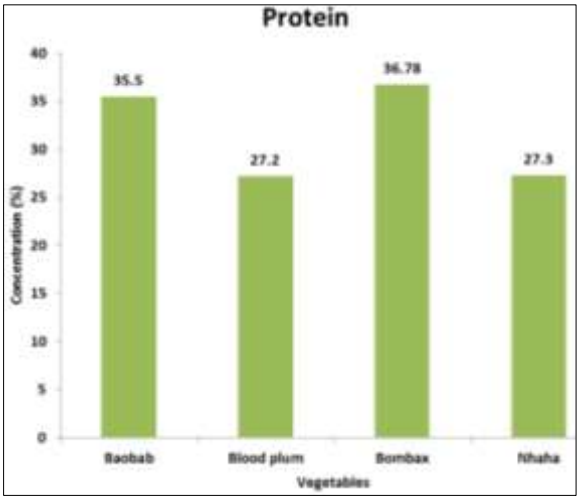

Fig 5: shows the comparison of the Protein in all the vegetables considered in the study

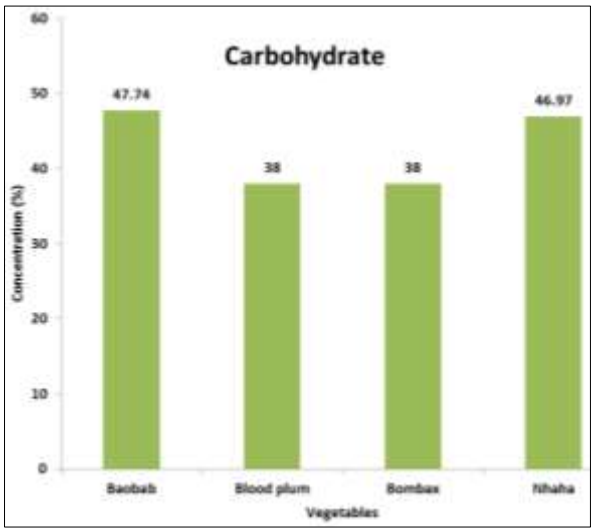

Fig 6: shows the comparison of the Carbohydrate in all the vegetables considered in the study

Discussion

The result showed that the leaves had the following range of mineral composition Ca (74.612±0.008 - 203.542±2.001), Cd (0.001±0.000 - 0.003±0.001), Pb (0.001±0.000 - 0.002±0.001), Mn (3.440±0.003 - 13.085±0.811, Mg (22.831±0.451 - 124.156±2.23) and Zn (0.085±0.003 - 3.015±0.031) [Table 1]. The most abundant element is Ca. Calcium plays an important role in building and Maintaining strong bones and teeth, large part of human blood and extracellular fluids. Approximately about 99% of the body calcium is stored in the bones and teeth (Victor and Chidi, 2009) [37]. Therefore the studied plants are essential in building the level of calcium in the body.

Mn is a microelement essential for human nutrient; it acts as an activator of many enzymes (Vashishtha, Amod, Jacob, and Nayak 2007) [36]. It is also a cofactor of Decarboxylase, transfer's enzymes and hydrolase (Victor and Chidi, 2009) [37]. Mn is required for the synthesis of acid mono polysaccharides, such as chondroitin sulphate, to form the matrices of bone and eggshell because it activates several important enzyme systems. Consequently, skeletal deformity defects in shell quality occur when the Mn intake is inadequate (Mohammed and Sharif, 2011) [24].

Magnesium is an important mineral element in connection with circulatory diseases such as heart disease (Nwauzoma and Dawari, 2013) [26]. It is also an active component of several enzyme systems in which thymile pyrophosphate is cofactor oxidative phosphorylation is greatly reduced in the absence of magnesium. High magnesium concentration is a component of leaf chlorophyll in plants. Common forms of Mg deficiency in human include respiration and depressed deep tendon reflexives. Sources Mg include green vegetables and leaves (Afolayan and Jimoh, 2009) [3]. Nutritionists have considered the role of zinc in human fitness and recommended that they should be considered for preparation of herbal drugs (Udayakumar and Begum, 2004 [35]; Sadia, Faiza, and Shabnam 2011) [30].

Lead occurs naturally in the environment. Every one may be exposed to trace amount of lead through house hold dust, food, air, soil, drinking water and various consumer products (Njidda, Olatunji, and Garba 2013) [25]. Pb causes reproductive dysfunction which decreases sperm quality and altered sperm morphology and low androgen level (Asaolu and Asaolu 2010) [8]. In this study Pb was found to be very low. Cadmium is a very toxic metal that should be monitored to prevent Cd related diseases. Cadmium compounds are classified as carcinogens by several regulatory bodies (Dusa, Timothy, Magili and Tukur, 2017 [13]; Williams, Nachana'a, Kazhigila and Sajo 2019) [39]. On longer time of accumulation, Cd causes kidney problem, liver, including heart, brain and eye problem (Bamishaiye, Olayemi, Awagu and Bamshaiye, 2011) [9]. However, Cd in this study was very negligible.

The proximate chemical analysis of a food is the nutritional composition of that food; it is the estimation of the nutritive value of human food in chemical form (Williams, Nuhu and Nachana'a 2020) [40]. The result of the proximate chemical analysis revealed the presence of Ash content, Moisture content, Crude fibre, Crude lipid, Crude protein and Carbohydrate. Carbohydrate was found to be the highest among all the proximate analysis carried out in this study (Table 2). It was recorded to be higher in Baobab among all the vegetables (Figure 1). Ash in food is the residue remaining after all the moisture has been removed as well as the organic materials (fat, protein, organic acid, carbohydrate, vitamins, etc) have been incinerated at a temperature of about 500^0C (Boroomand and Grouh, 2012 [10]; Mann and Otori, 2014) [20]. Ash content is generally taken to be a measure of the mineral content of the original food.

Moisture content is among the most vital and mostly used measurement in the processing, preservation and storage of food (Mann and Otori, 2014) [20]. In this study the moisture content observed range from 4.50% - 6.00% (Table 2) and the percentage was found to be higher in Bombax (Figure 2).

Crude fibre in food or plant is an indication of the level of non-digestible lignin and carbohydrate. The result obtained in this study showed a good amount of fibre, which indicate that it can serve as a good source of fibre that can aid digestion, help in reducing risk of coronary heart disease, serum cholesterol level, Intracolonic pressure that is beneficial in diverticular disease and hypertension. Plants with high fibre are adequate for better rumination and digestion in ruminant animals (Boroomand and Grouh, 2012 [10]; Adinortey, Sarfo, Quayson, Weremfo, Adinortey, Ekloh *et al.*, 2012) [2]. The high fibre content is a

further confirmation of its use as vegetable. In this research, Crude fibre was found to range from 1.32% - 5.15% (Table 2) and was found to be higher in blood plum as indicated in Figure 3Crude lipid is the principal sources of energy, many body functions depend on lipids. Lipid provides very good sources of energy and an aid in transport of insulates, fat soluble vitamins and protects internal tissues and also contributes to important cell processes. Therefore it is good to add lipid (fat) to most of our diets. One gram of lipid provides 9.0 kcal (37.33 kJ) of energy (Mann and Otori, 2014) [20]. In this study Crude lipid ranges from 2.44% - 11.17% (Table 2) and was found to be higher in Bombax as shown in Figure 4.

Proteins are essential component of the diet needed for survival of animals and humans, which function basically in nutrition by supplying adequate amounts of required amino acids (Williams, Nachana'a, Kazhigila and Sajo 2019) [39]. In this research, protein was found to range from 27.2- 36.78% (Table 2) and was found to be higher in bombax as indicated in Figure 5

Carbohydrates are polar compounds which are readily converted into glucose as source of energy (Williams, Nachana'a, Kazhigila and Sajo 2019) [39]. The carbohydrate content in the vegetables under study shows the range of 38.0 – 47.74% (Table 2). The result shows significant amount of carbohydrate in all the vegetables, thou the highest value were recorded in Baobab (Figure 6) and hence they can be utilized as a source of carbohydrate.

5. Conclusion

The proximate chemical analysis of food is the nutritional composition of that food; it is the estimation of the nutritive value of human food in chemical form. This study showed that Baobab, Blood plum, Bombax costatum and Ndaha possesses some appreciable amount of essential nutrient and mineral elements needed for the maintenance of good nutritional status and they compete favorably with commonly consumed vegetables. This indicates that the plants could be a source of minerals in diet as well as drugs in pharmaceutical industries.

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