Original Research Article

EVALUATION OF NUTRITIONAL, NON-NUTRITIONAL, ELEMENTAL CONTENT AND AMINO ACID PROFILE OF *Azanza garckaena* (GORON TULA)

ABSTRACT

Azanza garckeana, fruit, leave, stem-bark and roots were both quantitatively and qualitatively analyzed to determine the nutritional, non-nutritional, elemental and amino acid content. The nutritional (proximate) analysis reveals the highest and lowest moisture content in the fruit (6.50%) and stem-bark (0.50%), crude protein in the fruit (12.00%) and stem-bark (4.91%), crude fibre in the stem-bark (45.30%) and fruit (20.75%), lipid content in the leave (2.56%) and root (0.68%), and total ash content in roots (8.70%) and fruit (6.7%) respectively, while vitamin A, B_1, B_2, C and E were all found (in the fruits and leaves), and quantitatively more in the fruits. *A. garckeana* contains alkaloids, tannins, flavonoids steroids, cardiac glycosides, terpenes, phenols, volatile oils, resins and saponins. However, there is a significant variation in the presence of these compounds in the different parts of plant. The amount of these compounds were also found to be safe (i.e. below established toxic levels), and medicinal. The mineral elements present are also below toxic levels, and may contribute to the dietary requirements of the elements. The amino acid profile reveals 17 types; 7 essential, 2 semi-essential and 8 non-essential in the fruits and leaves in varying amounts.

Key words: *Azanza garckeana*, nutrition, non-nutrition, mineral elements, amino acids.

INTRODUCTION

In many tropical countries, rural dwellers traditionally harvest wide range of leafy vegetables, roots, tubers, and fruits from the wild as food supplements, spices, and sometimes for cultural uses. Labeled as famine or hunger food, some wild plants have been recognized to have the potentials to meet household food and income security [1, 2]. The indigenous fruits collected from the wild plays a significant role in food and nutrient security of the poor and rural dwellers. Some wild fruits have been identified to have better nutritional value than cultivated fruits [3, 4]. As a result, in recent years, a growing interest has emerged to evaluate various wild edible plants for their nutritional features [5, 6, 7, 8]. Like in many African counties, Nigeria's indigenous fruit trees, although undomesticated, play many important roles especially to the people living in rural areas. They are important traditional source of nuts, fruits, spices, leafy vegetables, edible oil and beverages [9]. Like the cultivated vegetables, wild indigenous fruit trees provide vitamins and minerals essential for the proper maintenance of human health [10]. According to FAO [11] and Maghembe, *et al*., [12] the nutritional value of indigenous fruit bearing tree species indicates that many are rich in sugars, essential vitamins and minerals, while others are high in vegetable oil and protein contents. In addition to fruit production and cash, the extensive list of benefits includes firewood, fodder, building material, shade and medicine especially to rural communities. Edible wild leaves and fruits are consumed frequently in Northern Nigeria especially in rural communities where a variety of edible leaves and fruits abound. Some of these are cultivated while others grow in the wild. Several of these wild species bear fruits/leaves during the dry season when cultivated fruits/leaves are scarce [13]. Wild fruits offer a convenient but cheap means of providing adequate supplies of mineral, fat, protein and carbohydrate to people living within the tropics [3]. In North eastern part of Nigeria (Gombe State) where common fruits and leaves like bananas and bitter leaves are in short supply, it is possible for wild fruits and leaves of *A. garckaena* (Goron Tula) to provide the vitamin and mineral requirement of the local populace (Tula people). Affordability as a factor is responsible for the high incidence of malnutrition in low income families that traditionally have a large family size in the study area [13]. Most affected are children of preschool age group with most cases of morbidity related to inadequate intake of food containing essential nutrients [6, 13]. Though *A. garckeana* may provide the necessary nutrients needed for body, the availability of these nutrients after ingestion depends on the non-nutritional factors present in the fruits and leaves of the plant. The non-nutrients tend to bind to mineral elements there by forming indigestible complex. Oxalate for instance binds to calcium to form complexes (calcium oxalate crystal). These

crystals formed prevent the absorption and utilization of calcium. The calcium crystals may also precipitate around the renal tubules thereby causing renal stones [6, 13].

Azanza garckeana is a semi-deciduous tree/shrub with a rounded medium crooked stem [14, 15]. The tree can grow to a height of 3-15 meters depending on the environment in which it is growing [15, 16, 17, 18, 19]. The twigs are hairy when young but become smooth with age and branches have wooly hairs [20]. The leaves are distinctively rounded 8 to 12 cm long stalks. They are always simple, alternate and roundish. The leaves have 3 to 5 lobes, which are covered in brown star-shaped hairs, and have longitudinal fissures in the midrib [15, 18, 20]. The flowers have many stamens and 5 petals, which are yellow or purplish in colour with dark purple or dark red centre [15]. The flowers are bisexual with all floral parts in five's [18]. It flowers in wet season and fruits in dry season (April-August) [18]. The fruits are spherical and woody, 2.5 cm to 4 cm in diameter long with short hairs. The fruits are divided into 4 to 5 sections. They are yellowish to brownish green and hairy when mature [15, 20]. *A. garckeana* is widely distributed in East and Southern Africa countries like Botswana, Kenya, Malawi, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe [15]. ICRAF [20], Mbuya, *et al.,* [21] and Mulofwa , *et al.,* [19], reported the species growing from Sudan to South Africa. In addition, it is also found in Gombe state, Nigeria, West Africa. The species grow naturally in all types of woodlands from sea level to about 1700 m above sea level [15, 17, 19, 21]. It grows in semi-arid areas receiving lowest annual rainfall of 250 mm and highest rainfall of 1270 mm [18]. Over the range in its entirety, the species grows in a variety of soils and is found on or near termite mounds and deserted village fields [17, 18, 19, 21]. In Botswana *Azanza garckeana* grows in open woodland in north-eastern part of the country. In Nigeria it grows in savanna areas in Tula District, Kaltungo Local Government Area, Gombe state. The fruits of *A. garckeana* when slightly green or when ripe, are eaten by the people of Tula community in Gombe State, Nigeria. Some people dry it and further process it for consumption. The fruits can also be soaked in small amount of water to make jelly [22]. They can also be boiled and used as relish or made into porridge [14]. Leaves are used for making relish and burned to produce salt, and also cooked as vegetables. The leaves can also be used as green manure to improve land productivity [23]. Traditionally, the roots and steam/bark are used to treat gonorrhea.

Figure 1: Typical *A. garckaena* plant

Due to the importance of these nutrients as a basic condition for good human health, we therefore found it necessary to evaluate the nutrient contents of *A. garckaena* fruits and other plant parts. This work would provide necessary information on the fruits, plant parts and also provide the basis for their wider utilization.

MATERIALS AND METHODS

Collection and treatment of samples

A. garckeana (Goron Tula) fruits, leaves, roots and stem/bark were randomly collected from different stands of the plant growing wild in Tula Town in Kaltungo Local Government Area Gombe state in August, 2014. The fruits and the plant parts were air dried in the laboratory. They were then grounded into fine powder using pestle and motor (Stainless steel) and stored in screw capped containers.

Proximate analysis

Sample preparation and proximate analysis were carried out by adopting the method described by Nkafamiya and his co-workers [24].

Determination of vitamin (A, B_1, B_2, C, and E) content (leaves and fruits)

Vitamin content was determined according to the method described by Nkafamiya *et al.,* [6]. Mean values from triple determinations were recorded.

Analysis of minerals and amino acids (leaves and fruits)

The mineral elements was analysed using an atomic absorption spectrophotometer (AAS), Buck 210 VGP. Amino acid profile analysis was carried out according to standard method as described by Nkafamiya *et al.,* [24].

Determination of non-nutrients

This was carried out by adopting same methods as in Idris et al., [25]. In all the analysis, reagents were of analytical grades and were not subjected to further purification.

RESULTS AND DISCUSSION

The results of the proximate analysis of *A. garckaena* fruits, leaves, roots and stem-bark are presented in Table 1. The fruit is the most proteinous part (12.0 %) and also with the highest moisture content (6.50 %), while the stem-bark is the least (4.91%) and (0.5 %) respectively. The stem-bark contains the highest carbohydrate content (72.16 %), closely followed by roots (70.81 %), while the least content is obtained from the fruit (28.40 %). Crude fiber content was found to be highest in fruits (45.00 %) followed by leaves (25.00 %), stem-bark (13.75 %) and roots (11.89 %). This considerable amount of crude fiber implies that *A. garckaena* (especially the fruits and leaves) will perform the role of stool softening, with optimum frequency and regularity of elimination, which is characteristic of fibre-rich diet (Nkafamiya *et al.,* 2010). The highest total ash content was found in the leaves (11.00%), and the least in the fruit (6.70%) (w/w). Comparing this result with the one reported by Nkafamiya *et al*., [24] for *F. asperifolia* and *F. sycomorus,* the ash contents are comparable, while the other results obtained for *A. garckaena* parts are correspondingly lower. However, values obtained are within the range expected for dry leaf vegetables [24].

Table 1: Proximate Composition of *A. garckeana* (%)

Part of plant	Moisture content (w/w)	Crude protein (w/w)	Crude fibre (w/w)	Lipid content (w/w)	Total ash (w/w)	Total carbohydrate (w/w)
Fruits	6.50	12.00	45.30	1.10	6.70	28.40
Leaves	5.50	5.60	25.00	0.96	11.00	49.94
Roots	2.70	7.42	11.89	0.68	8.70	70.81
Stem/bark	0.50	4.91	13.75	1.12	7.56	72.16

The non-nutritional component of the fruits, leaves, stem-bark and roots are presented in Table 2 (qualitative) and Table 3 (quantitative). These are compounds that limit the wide use of many tropical plants due to their ubiquitous occurrence as natural compounds capable of eliciting deleterious effect on man and animals [24, 26]. Alkaloids, steroids, cardiac glycosides, terpenes, resins and saponins are present in the plant parts (fruits, leaves, roots and stem-bark). Volatile oils are present in the fruits, leaves and the roots. Flavonoids are present in the fruits and leaves. Phenols and tannins are present only in leaves and fruits respectively. This result (especially the fruits and leaves) is comparable with those reported for some medicinal plants by Kubmarawa et al., [27] and Idris et al., [25].

Table 2: Qualitative Screening of Non-nutritional Constituents of A. garckeana

Part of plant used	Alkal-oids	Tan-nins	Flavo-niods	Ster-oids	Cardiac glycol-sides	Terp-enes	Phen-ols	Vola-tile oils	Res-ins	Sapo-nins
Fruit s	+	+	+	+	+	+	-	+	+	+
Leaves	+	-	+	+	+	+	+	+	+	+
Roots	+	-	-	+	+	+	-	+	+	+
Steam-bark	+	-	-	+	+	+	-	-	+	+

Key: + present; - Not detected

The quantitative estimation of the non-nutritional factors (Table 3) indicated that alkaloid has the highest value in fruits (18.40 %) and lowest in roots (6.80 %). Leaves has the highest value of flavonoids (26.50 %) followed by the fruits (24.40 %). Flavonoids were not detected in the root and stem-bark. Saponins are not also detected in the fruits (concentration is below the detection limit of the procedure used), but has the highest value in leaves (39.00 %) followed by the stem-bark (34.50 %). Tannins were not detected in the leaves (concentration is below the detection limit of the procedure used), roots and stem-bark, but amount to 15.05% in the fruits. Phenols quantitatively amount to 29.00% of the plant leaves where it was only found. Although very medicinal [25], non-nutritional compounds above some threshold intake can bind to mineral elements there by forming indigestible complex. Oxalate for instance tends to render calcium unavailable by binding to the calcium ion to form complexes (calcium oxalate crystals). These oxalate crystals formed prevents the absorption and utilization of the calcium. The calcium crystals may also precipitate around the renal tubules thereby causing renal stones [24]. The non-nutritional compounds present in the plant parts are generally below the established toxic level [13, 24]. This thereby potentially recommends the plant parts (especially the fruit and leaves) for medicinal uses.

Table 3: Quantitative Screening of Non-nutritional Consistiuents

Part of plant used	Alkaloids %(w/w)	Flavoniods % (w/w)	Saponins % (w/w)	Tannins % (w/w)	Phenols % (w/w)
Fruit s	18.40	24.40	ND	15.05	ND
Leaves	13.60	26.50	30.00	ND	29.00
Roots	6.80	ND	24.50	ND	ND
Steam bark	12.80	ND	34.50	ND	ND

Key: ND not detected

Table 4 presents some mineral composition of the fruits and other plant parts. The levels of mineral elements in fruits are higher than those found in the fruits of *C. congoensis, N. latifolia* and *C. panados* [13, 28]. Iron and zinc are among the essential elements for humans, and their amount (especially in the fruits and leaves) of *A. garckaena* are promising since the adult daily requirements are 15 and 18 mg, respectively. The iron level is also higher than some of the cultivated fruits like orange (0.2 mg/100 g) and mango (0.4 mg/100 g) [13]. Compared to the other parts, the fruits and leaves of *A. garckaena* generally have appreciable levels of mineral elements. Therefore, consumption of *A. garckaena* parts, specifically the fruits and leaves, could contribute immensely to the overall daily intake of these elements in amounts that will alleviate symptoms associated with their deficiency such as; hypercholesterolemia, demineralization of bones, microcytic anemia and immunocompetence (in pregnant and menstruating females) resulting from copper and iron deficiency, weakness, cardial arrhythmia, poor growth, impairment of sexual development and poor wound healing as a result of magnesium and zinc deficiency [13].

Table 4: Concentration of mineral elements in plant parts (mg/100 g)

Element	Fruits	Leaves	Roots	Stem/bark
Ca	127 ± 0.04	129 ± 0.45	100 ± 0.04	28.02 ± 0.89
Cd	ND	ND	ND	ND
Co	0.02 ± 0.01	0.04 ± 0.02	0.01 ± 0.25	0.01 ± 0. 91
Cr	ND	ND	ND	ND
Cu	0.45 ± 0.33	2.01 ± 0.25	0.01 ± 0.35	0.12 ± 0. 97
Fe	12.00 ± 0.43	15.00 ± 0.73	5.05 ± 0.23	6.00 ± 0.36
Mg	96.25 ± 0.67	100.00 ±0.12	45.05 ± 0.24	40.09 ± 0.45
Mn	0.02 ± 0.23	0.01 ± 0.24	0.01 ± 0.98	0.01 ± 0. 24
Ni	ND	ND	ND	ND
P	30 ± 0.87	29.07 ± 0.07	10.09 ± 0.90	9.09 ± 0.6 7
Pb	ND	ND	ND	ND
Zn	12.02 ± 09	11.06 ± 21	6.09 ± 07	5.06 ± 23

The vitamin content of the fruits and leaves of *A. garckaena* is presented in Table 5. The vitamin content with the exception of vitamin C is higher compared to those found in the fruits of *C. congoensis* and *N. latifolia* [13]. Consumption of the fruits and leaves of *A. grackaena* can serve as vitamin supplements. Presence and amount of vitamin A and E in the fruits and leaves presents them as a potential remedy for symptoms associable with the deficiency of the vitamins e.g. night blindness and peroxidation. The value of vitamin C in both fruits and leaves of *A. garckaena* is low compared to the fruits of *C. congoensis* (410.50 ± 0.32 mg/100 g ripe) and *N. latifolia* (309.00 mg/100 g ripe). Though the value of vitamin C of *A. garckaena* is low compared to those of the

fruits of *Congoensis* and *N.latifolia*, the fruits and leaves may prove important in the prevention of scurvy and alleviate symptoms of common cold [13].

Table 5 Vitamin content (mg/100 g) of *A. garckaena* fruits and leaves

Fruits/leaves	A*	B_1	B_2	C	E
Fruits	75.00 ± 0.23	1.28 ± 0.97	1.18 ± 0.45	319.09 ± 0.45	3.08 ± 0.55
Leaves	28.75 ± 0.66	1.00 ± 0.67	0.95 ± 0.78	98. 02 ± 0.65	2.09 ± 0/77

- Value in µg/100 g.

Values are means ± SD of 3 determinations.

Table 6 present the amino acid composition of *A. garckaena*. Essential amino acids were present in both the fruits and leaves and are higher than that of *F asperifolia* and *F. Sycomorus* [24]. Leucine had the highest value for both the fruits and the leaves, while glycine had the lowest. Result is comparable with the result presented by Nkafamiya and his coworkers [24].

Table 6. Amino Acid Composition of the Fruits and Leaves of *A. garckaena.*(g/100 g)

Amino acid	Fruits	Leaves
Alanine	3.30	4.00
Arginine	7.01	7.69
Aspartic acid	9.67	10.97
Cysteine	3.00	3.66
Glycine	1.00	1.23
Glutamic acid	10.79	11.09
Histidine	3.67	4.00
Isoleucine	4.98	5.00
Leucine	12.01	12.97
Lysine	11.78	12.85
Methionine	2.00	2.78
Phenylalanine	8.00	9.00
Proline	4.00	4.78
Serine	3.97	4.00
Threonine	4.78	4.97
Tyrosine	4.89	4.99
Valine	6.00	6.76

CONCLUSION

This study presents the nutritional and toxicological evaluation of *A garckaena* which is a wild plant. *A garckaena* contains appreciable levels of nutrients in its various parts (especially the fruits and leaves). The presence and amount of some phytochemicals and mineral elements analyzed has also indicated that the consumption of the plant (especially the fruits and leaves) be medicinal and of dietary value respectively, rather than toxic. The 2 semi-essential (Arginine and Histidine), and 7 out of the 8 essential amino acids were found in appreciable amounts in the fruits and leaves. This consistently indicates the proteinous content of the plant parts. The study therefore further recommends the consumption of *A garckaena* (especially the fruits and leaves), while other parts may serve as raw materials for nutrients and medicinal substance extraction.

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