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Proximate, mineral and anti-nutrient composition of *Gardenia Aqualla* seeds

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ABSTRACT

The seeds of Gardenia aqualla fruit were analysed for nutritional and anti-nutritional composition using standard analytical methods. The results obtained were moisture content (49.00 %), ash (5.20 %), crude lipid (1.90 %), crude protein (4.46%), crude fibre (1.00 %), available Carbohydrate (87.64 %) and the energy value (384.70 kcal/100g). Elemental analyses show that potassium is the most abundant element in the seeds while chromium is the least (1.30mg/100g). Lead was also detected (0.43 mg/100g). The result of anti-nutritional evaluation indicate the presence of phytate (2.74 mg/100g), soluble oxalate (2.74mg/100g), saponin (5.10 mg/100g), nitrate (0.52mg/100g) and hydrocyanic acid (0.14 mg/100g). The antinutrients to nutrients ratio indicate the availability of some important minerals. The results indicate that the seed which is usually thrown away as waste can serve as a good source of some minerals and carbohydrate which if properly utilized would assist in combating the problem of malnutrition in the society.

Key words: *Gardenia aqualla* , Proximate, Mineral, Anti-nutrient, Seeds.

INTRODUCTION

In Africa, studies indicated that vast number of indigenous wild plant exist and play a significant role in our diets (Umar *e t al.*, 2008). Several measures are being taken by various levels of government to boost food production by conventional agriculture. However, a lot interest is currently being focused on the possibilities of exploiting the vast number of wild plant resources (Abdullah and Abdullah, 2005).

Many of such plants have been identified, but lack of data on their chemical composition has limited the prospect of their utilization (Baumer, 1995). Many reports on some lesser known seeds and fruits indicate that they could be good sources of nutrients for both man and livestock (Elemo *et al*., 2002; Adekunle and Ogerinde, 2004).

Researches have shown that the seeds not only contain nutritionally important bio compounds but are also sources of other phyto-compounds which at certain critical levels have significant anti-nutritional effects (Omorayi and Dilworth, 2007).

G. aqualla fruit is yellow in colour and oval in shape when mature, it is a seasonal fruit mostly available during hamattan and is eaten raw. It has seeds inside it, while the pulp is eaten as food while the seeds are thrown away as waste.

MATERIALS AND METHODS

Sample collection

Riped fruit of *Gardenia aqualla* were obtained from different locations in Zuru hill Kebbi state, Nigeria. The samples were mixed together and representative samples were picked at random (Muhammad *et al.*,2011; Asaolu and Asaolu, 2002).

The fresh fruits were authenticated at the Herbarium of the Department of Biological Sciences Usmanu Danfodiyo University, Sokoto.

The sample fruits were washed with distilled water to avoid surface contamination (Ahmed and Birnin Yauri, 2008). The flesh of the fruit and the seeds were separated using plastic spoon after dividing the fruit into two. The seeds were dried at room temperature, crushed to a fine powder using mortar and pestle, sieved through 20-mesh and stored in air tight plastic containers for analysis.

Proximate Analysis

Moisture content was determined at 105^0 C in an oven. Ash content was determined at 550^0C. Crude protein, lipid and fibre were determined according to the procedures of AOAC (1990), Crude nitrogen was determined based on the Kjeldahl procedure and crude protein value was obtained by multiplying the nitrogen value by a factor of 6.25 while estimation of available carbohydrate was done by difference according to equation (1).

CHO = 100-(% ash+% crude protein +% crude lipid+% fibre).---- - - (1)

Energy kcal = [(% CHO x 4) + (% CP x 4) + (CL x 9)] (Hassan *et al*., 2008).

Mineral Analysis

The mineral elements were analysed using Walinga *et al*. (1989) method, the mineral elements in the sample were brought into solution by wet digestion technique using a mixture of conc. nitric, perchloric and sulphuric acids in the ratio 9:2:1 respectively. Fe, Zn, Cr, Co, Mg, Ca, Cu, Mn and Pb were determined by AAS, while Na and K were determined using atomic emission spectrometer and colorimetric method was used to determine phosphorus.

Antinutritional Analysis

Oxalate was determined by the method of Krishna and Ranjhan (1980), while phytate and hydrocyanic acid were determined by the AOAC (1990) method. Nitrate was determined by IITA (1988) method.

RESULTS AND DISCUSSION

Table 1, 2, 3 and 4 show the results obtained from the analyses.

Table 1: Proximate Composition of the Seeds of *G. aqualla* Fruit.

Component Analyze	Values
Moisture (%W/W)	49.0 ± 0.50
Ash (%D/W)	5.20 ± 0.28
Crude lipid(%D/W)	1.90 ± 0.28
Crude protein (%D/W)	4.26 ± 0.18
Crude fibre (%D/W)	1.00 ± 0.0
Available Carbohydrate (%DW)	87.64 ± 0.38
Energy value (kcal per 100g)	384.70 ± 2.08

The data are mean value ± standard deviation of triplicate results., D/W=dry weight and W/W=wet weight.

Table 2: Mineral Composition of Seeds of *G. aqualla* Fruit (mg/100g dry weight)

Element	Concentration(mg/100g)
Ca	4.80 ± 0.06
Mg	22.0 ± 0.17
Na	200 ± 20.0
K	373.33 ± 15.30
P	76.10 ± 0.12
Cu	2.80 ± 0.06
Fe	10.13 ± 0.15
Zn	4.17 ± 0.21
Mn	2.60 ± 0.06
Pb	0.43 ± 0.60
Cr	1.30 ± 0.06
Cd	3.10 ± 0.10
Co	1.13 ± 0.11
Ni	ND

ND = Not detected, The data are mean value ± standard deviation of triplicate results.

Table 3: Levels of some Antinutritive Factors in the Seeds of *G .aqualla* Fruit.

Antinutritive factors	Concentration (mg/100DW)
Cyanide	0.14 ± 0.01
Nitrate	0.52 ± 0.25
Phytate	4.51 ± 0.64
Saponins	5.10 ± 0.20
Total Oxalate	2.96 ± 0.30
Soluble oxalate	2.74 ± 0.01

The data are mean value ± standard deviation of triplicate results.

Table 4: Antinutrient to Nutrients Molar Ratio of *G.aqualla* Seeds

Antinutrient to nutrient Ratio	Value	Critical level
[Oxalate]/ [Ca]	0.25	2.5
[Oxalate]/ [(Ca + Mg)]	0.03	2.5
[Ca][Phytate]/ [Zn]	0.02	0.5
[Phytate]/ [Zn]	0.17	10
[Phytate]/ [Ca]	0.08	0.2
[Phytate]/ [Fe]	0.06	0.4

Critical values were sourced from Hassan *et al*., (2011).

The low moisture in the seed offers it some storage advantage (Umar and Birnin-Yauri, 2005). The percentage ash of the sample gives an idea about the inorganic content of the sample from where the mineral content could be obtained. Sample with high percentage of ash content is expected to have high concentration of various mineral elements, which are expected to speed up metabolic processes and improve growth and development.

The sample has low lipid content which justifies the general observation that, fruits and vegetable are not good sources of fats and oils (Hassan *et al*., 2002). Although it might be relegated as source of oil commercially, it can be recommended as part of weight reducing diet, since low fat food reduces the level of cholesterol and obesity (Gordon and Kessel, 2002).

From the result, the seeds contain some quantity of protein; unfortunately it is the part that is thrown away as waste. Although the seed has low protein concentration it can serve as source of protein considering the level of protein deficiency in the society.

Fibre containing food are known to expand the inside walls of the colon, and ease the passage of waste. It also lowers cholesterol level in the blood and reduce the risk of various cancers. But emphasis has been placed on the importance of keeping fibre intake low in the nutrition of infants and weaning children because high fibre levels in weaning diet can lead to irritation of the gut mucosa (Bello,*et al*.,2008). It also enhances gut perturbation in young animals like piglets and chickens (Eromosele and Eromosele, 1991).

The sample could be considered as a potential source of carbohydrate when compared to the content of some conventional sources like cereals 72-90g/100g (Adewusi *et al*., 1995). If properly utilized the sample can be a good source of energy for both human and animals.

A healthy adult should eat less than 2400 mg of sodium per day to reduce the risk of elevated blood pressure because, on the average, the higher an individuals salt intake the higher his blood pressure. Keeping blood pressure in the normal range reduces an individual's risk of coronary heart diseases, stroke, congested heart failure and kidney diseases (NRC, I989).

Going by the result obtained in this study the seed is a better source of phosphorus, especially when compared to its recommended dietary allowance 800 mg/day.

Potassium is the most abundant element found in the seed of the fruit 373 mg/100g. High amount of potassium in the body was reported to increase iron utilization (Adeyeye, 2002) and beneficial to people taking diuretics to control hypertension and suffer from excessive excretion of potassium through the body fluid (Arinathan, *et al*., 2003).

The iron content of the seed is 10.13mg/100g, Iron is said to be an important element in the diet of pregnant women, nursing mothers, infants convulsing patients and elderly to prevent anaemia and other related diseases (Oluyemi *et al*., 2006). The recommended dietary allowance of iron is 2-5mg/day (NRC, 1989).

The magnesium content of the seed is 22.00mg/100g and itplays a major role in relaxing muscle along the airway to the lungs thus, allowing asthma patients to breathe easier. It plays fundamental roles in most reactions involving phosphate transfer (Appel, 1999).

The concentration of manganese in the seed is 2.6 mg/100g and it helps in giving support to the immune system, regulation of blood sugar levels, production of energy and cell reproduction. It works with vitamin K to support blood clotting, working with the B complex vitamins, manganese helps to control the effects of stress. Birth defects can possibly result when an expecting mother does not get enough of this important element (Anhwange *et al*., 2004).

The calcium content of the seed is 4.80 mg/100g; Calcium helps in regulating muscle contraction. It is also required by children, pregnant and lactating women for bones and teeth development (Margaret and Vickery, 1997).

The result of this analysis shows that the concentration of zinc in the seed is 4.17 mg/100g, Zinc is said to be an essential trace element for protein and nucleic acid synthesis and normal body development, vital during periods of rapid growth such as infancy, adolescence and during recovery from illness (Melaku, 2005).

The concentration of copper in the fruit pulp and seed is 2.80 mg/100g; deficiency of copper has been reported to cause cardiovascular disorders as well as anaemia and disorder of the bone and nervous systems (Mielcarz *et al*., 1997).

The chromium content of the seed is 1.26mg/100g. The presence of chromium in the sample might not be unconnected to the nature of the rock on which they grow, because one of the ways by which chromium gets to some compounds in the environment is through erosion of chromium containing rocks (Kotas and Stasicka, 2000). But the estimated safe and adequate daily intake of chromium for adults is 0.2 mg/100g (NRC, 1989). High dietary intake of chromium Cr^{3+} has not shown any deleterious effects due to inability of human to oxidize Cr^{3+} to potentially carcinogenic Cr^{6+} compounds. (Cabrera *et al*., 1996).

The lead concentration in the seed is 0.43 mg/100g. The presence of lead in the sample might not be unconnected to the nature of the rock from which they are obtained. The concentration of lead found in this study is within the accepted range 0.02mg/100g-2.0mg/100g of lead in plant materials (Miroslav and Vladimir, 1999). But the consumption of this sample should be with caution so as to avoid lead deposition in the body which may be detrimental to health.

Lead is a poisonous metal that can damage nervous connection especially in young children and can also affect their faculty of reasoning. Increased lead absorption may give rise to effects on both the central and peripheral nervous systems (Lin-Fu, 1976).

The concentration of cobalt in the seed is 1.13 mg/100g, the presence of this metal is also attributed to the nature of the mountain where the sample grows. The contents of cobalt found in this study are below the concentration that is said to be critical in plant materials (1.5 mg/100g-5.0 mg/100g) (Miroslav and Vladimir, 1999). Cobalt plays a role in the metabolism of vitamin B-12 hence increase body ability in its absorption, it also function as an activating ion in some enzymes (McDonald,1995).

The concentration of cadmium in the seed is 3.1 mg/100g, the values of cadmium content in this study are within the range that are considered critical in plant materials (0.5mg/100g-3.0mg/100g) (Miroslav and Vlandimir, 1999). Studies have shown that there is a connection between cadmium intoxication and bone damages e.g *Itai-Itai* disease which is characterised by symptoms of low grade bone mineralization, high rate of fracture and intense bone associated pains. High oral ingestion of cadmium causes vomiting, diarrhoea leading to coma and death (McDonald, 1995).

The phytate content of the seed is 4.51 mg/100g. The problem with phytate in food is that it can bind some essential mineral nutrients in the digestive tract and can result in mineral deficiencies (Bello *et al*., 2008). The phytate composition of the sample is lower and might not pose any health hazard when compared to a phytate diet of 10-60 mg/g which if consumed over a long period of time that has been reported to decrease bioavailability of minerals in monogastric animals (Thompson, 1993).

The concentration of hydrocyanic acid in the seed is 0.14 mg/100g, this shows that the level of the acid in the sample is within the permissible range for human consumption. Only plants with more than 200mg of hydrocyanic acid equivalent per 100mg fresh weight are considered dangerous (Betancur-Ancona *et al*., 2008). Consumption of high levels of cyanide is associated with a serious health problem, a neurological disease known as Tropical Ataxis Neurophathy (TAN) which is linked to consumption of high level of cyanide in cassava based diet (Hassan and Umar, 2004).

The concentration of saponin in the seed is 5.10 mg/100g. High level saponin has been associated with gastroenteritis manifested by diarrhoea and dysentery (Awe and Sodipo, 2001) but it was reported that saponin reduces body cholesterol by preventing its reabsorption and suppresses rumen protozoan by reacting with cholesterol in the protozoan cell membrane there by causing it to lyse (Umaru *et al*., 2007).The value of saponin obtained in this study is not up to the toxic level.

The concentration of nitrate in the seed is 0.52 mg/100g; these values are within the acceptable daily intake of 3.7 mg/kg body weight (WHO). Higher concentration of nitrate in the food can lead to a disease called methemoglobinemia which is known to reduce the ability of red blood cells to carry oxygen (Kim-Shapiro, *et al*., 2005).

Antinutrients to nutrients ratios were calculated so as to predict the bioavailability of some divalent elements (i. e Ca, Mg, Fe and Zn). It was found that [Oxalate]/[Ca] ratio in the seed (0.25) and [Oxalate]/(Ca+ Mg] ratio (0.03 **)** are below the critical level of 2.5 at which it impaired calcium bioavailability (Umar, 2005). Thus it indicates that the consumption of this sample cannot hinder calcium bioavailability.

To predict the effect of phytate on the bioavailability of Ca, Fe and Zn. Phytate to nutrients ratios were calculated. It shows that [Phytate] / [Ca] ratio in the seed was below the critical level of 0.2 like-wise the ratio [Phytate]/[Zn] of (0.17) for the seed is also below the critical level of 10.

[Ca][Phytate][Zn] ratio was found to be a better measure of zinc bioavailability than [Phytate][Zn] ratio (Obah and Amusan, 2009). The [Ca][Phytate][Zn] ratio in the seed is (0.02) which is below the critical level of 0.5, this shows that the bioavailability of Ca,Fe and Zn may not be hindered by the phytate content of the seed of *G. aqualla* fruit.

CONCLUSION

From the results it can be concluded that the seeds of *G.aqualla* could be good sources of some important minerals and carbohydrate which if properly utilized would assist in combating the problem of malnutrition in the society.

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