PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 10 (6): 577-581, 2011
ISSN 1680-5194

Proximate, Minerals and Anti-nutritional Factors of *Gardenia aqualla* (*Gauden dutse*) Fruit Pulp

A. Muhammad[1], S.M. Dangoggo[2], A.I. Tsafe[2], A.U. Itodo[1] and F.A. Atiku[1]
[1]Department of Chemistry, Kebbi State University of Science and Technology, Aliero, Nigeria
[2]Department of Pure and Applied Chemistry, Usmanu Danfodiyo University, Sokoto, Nigeria

Abstract: The Pulp of *Gardenia aqualla* fruit was analyzed for nutritional and anti-nutritional composition. The results obtained were moisture content (80.33%), ash (5.00%), crude lipid (1.70%), crude protein (3.85%), crude fibre (trace), available carbohydrate (89.45%) and the energy value (388.50 kcal/100 g). Elemental analyses shows that Sodium is the most abundant element (203.33 mg/100 g) while manganese is the least (0.2 mg/100 g), Lead was also detected (0.37 mg/100 g). The anti-nutritional parameters analyzed include; Phytate (26.57 mg/100 g), Soluble Oxalate (1.70 mg/100 g), Saponin (1.50 mg/100 g), Nitrate (0.38 mg/100 g) while Hydrocyanic acid content are (1.14 mg/100 g). The antinutrients to nutrients ratio indicate the bioavailability of some important minerals except in the case of [Phytate][Fe] and [Phytate][Ca] in the pulp which are found to reach the critical levels and therefore are expected to hinder Iron and Calcium bioavailability in the pulp.

Key words: *Gardenia aqualla* fruit, wild food, potassium, oxalate, phytate, saponins, nitrate, cyanide

INTRODUCTION

Over one billion people throughout the world are believed to gain part of their entire livelihood from the utilization of wild food. In Africa, studies indicated that vast number of indigenous wild plant exist and play a significant role in the diet of populace.

Some of these wild plants that are use by people which serve as food and sources of nutrients are fruits, because they provide some of the minerals that are essential for body building and regulating some body functions.

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 nutrient for both man and livestock (Elemo *et al*., 2002; Adekunle and Ogerinde, 2004).

In Nigeria, wild fruits are commonly consumed by both rural and urban dwellers especially during the dry season when most cultivated fruits are out of season (Barminas *et al*., 1998). Some of these wild fruits have higher nutritional values compared with levels found in cultivated fruits (Eromosele *et al*., 1991).

As earlier mentioned that fruits are good sources of protein, fats, carbohydrate and minerals. Nutritionally, they are also believed to contain beta carotene which act as an antioxidant and potentially protects against cancer and the degenerative aspects of ageing (Bello *et al*., 2008).

Researches have shown that fruits 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). These compounds include Oxalate, Phytate, Saponins and Nitrate, Cyanide etc.

Gardenia aqualla is a fruit that belongs to the Genus *Gardenia* in the phylum *Tracheophyta*. It is a shrub/tree of 3-4 m high, stipules are present and the flowers are bisexual. It consists of pistil, carpels and a single style. The fruit is yellow in colour and oval in shape when matured, it is a seasonal fruit mostly matured during Hamattan and is eaten raw. It has seeds inside it, while the pulp is eaten as food the seeds are thrown away as waste.

MATERIALS AND METHODS

Sample collection: Ripened 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 (Asaolu and Asaolu, 2002).

The fresh fruits were authenticated at the Herbarium unit of the department of Biological Science of Usmanu Danfodio University Sokoto Nigeria.

The sample fruits were clean with water and rinsed 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 samples were dried at room temperature, crushed to a fine powder using mortar and pestle, sieved through 20-mesh and stored in an air tight plastic containers for analysis.

Corresponding Author: A.U. Itodo, Department of Chemistry, Kebbi State University of Science and Technology, Aliero, Nigeria

Proximate analysis: Moisture content was determined at 105°C. Ash content was determined at 550°C. Crude protein, lipid and fibre were also determined according to the procedures of AOAC (1990), Crude nitrogen was determined based on the Kjeldhal 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 as:

$$CHO = 100 - (\%ash+\%crude\ protein+\%crude\ lipid+\%fibre) \quad (1)$$

$$Energy\ (kcal) = [(\%CHO \times 4) + (\%CP \times 4) + (CL \times 9)] \quad (2)$$

Where CHO, CP and CL stands for carbohydrate, crude protein and crude lipid respectively (Hassan *et al*., 2008).

Mineral analysis: The sample was digested into solution by wet digestion 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 determined Phosphorus.

Antinutritional analysis: Oxalate was determined by the method of Krisna 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. The moisture content recorded in the fruit pulp is high which will provide an enabling environment for the activities of micro organisms this will give the fruit a storage disadvantage (Ladan *et al*., 1997). The ash content recorded gives an insight that the sample contained some nutritionally important minerals, the value of crude lipid recorded is low so, the fruit can be recommended as a weight reducing diet since low fat food reduces the level of cholesterol and obesity (Gordon and Kessel, 2002). Although the fruit pulp have low protein concentration it can still serve as a source of protein considering the level of protein deficiency in the society.

The fibre content is trace although fibre containing food are known to expand the inside walls of the colon, easing the passage of waste, thus making it an effective anti-constipation, it 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 enhance gut perturbation in young animals (e.g. piglets and chickens) (Eromosele and Eromosele, 1991).

The samples could be considered as potential sources of Carbohydrate when compared to the content of some conventional sources like cereals 72-90 g/100 g Carbohydrate (Adewusi *et al*., 1995).

Potassium is the most abundant element found in the pulp of the fruit, 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 (Arinanthan *et al*., 2003). Iron is said to be an important element in the diet of pregnant women, nursing mothers, infants convulsing

Table 1: Proximate content of pulp of *G. aqualla* fruit

Component analyze	Pulp
Moisture (%WW)	80.30±0.20
Ash (%DW)	5.00±0.50
Crude lipid (%DW)	1.70±0.20
Crude protein (%DW)	3.85±0.30
Crude fibre (%DW)	Trace
Available carbohydrate (%DW)	89.45±0.64
Energy value (kcal per 100 g)	388.50±2.20

The data are mean value ± standard deviation of triplicate results. DW = Dry Weight, WW = Wet Weight

Table 2: Mineral composition of pulp of *G. aqualla* fruit (mg/100 g dry weight)

Element	Pulp
Ca	3.70±0.06
Mg	9.66±0.20
Na	203.33±0.35
K	12.10±0.10
P	2.23±0.11
Fe	5.70±0.00
Zn	11.03±0.73
Mn	0.20±0.01
Pb	0.37±0.06
Cr	1.07±0.06
Cd	2.50±0.00
Co	1.00±0.00

Table 3: Levels of some antinutritive factors in pulp of *G. aqualla* fruit

Antinutritive factors	Pulp values
Cyanide	1.14±0.02
Nitrate	0.38±0.01
Phytate	26.57±0.15
Saponins	1.50±0.26
Total oxalate	2.10±0.20
Soluble oxalate	1.70±0.07

The data are mean value ± standard deviation of triplicate results

Table 4: Antinutrient to nutrients molar ratio *G. aqualla* pulp

Antinutrient to nutrient ratio	Pulp values	Critical level
[Oxalate]/[Ca]	0.22	2.5
[Oxalate]/[(Ca + Mg)]	0.04	2.5
[Ca][Phytate]/[Zn]	0.02	0.5
[Phytate]/[Zn]	0.24	10.0
[Phytate]/[Ca]	0.44	0.2
[Phytate]/[Fe]	0.40	0.4

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

patients and elderly to prevent anaemia and other related diseases (Oluyemi *et al*., 2006). The recommended dietary allowance of iron is 2-5 mg/day (NRC, 1989). Calcium and Phosphorus containing substances are required by children, pregnant and lactating women for bones and teeth development (Margaret and Vickery, 1997).

Magnesium plays 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; believe to be essential in the structural stability of nucleic acid and intestinal absorption while its deficiency in man is responsible for severe diarrhoea and migraines (Appel, 1999).

Manganese is believed to support the immune system, regulates blood sugar levels and is involved in the 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).

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).

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 presence of chromium in samples might not be unconnected from 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 Stasiscka, 2000). But the estimated safe and adequate daily intake of chromium for adults is 0.2 mg/100 g (NRC, 1989). High dietary intake of chromium Cr^{3+} have 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 presence of lead in the sample might not be unconnected to the nature of the rock from which they are obtained, because erosion from lead containing rocks is one of the ways by which lead gets into plant materials (Lin-Fu, 1976). The concentration of lead found in this study are within the accepted range of lead in plant materials 0.02 mg/100 g-2.0 mg/100 g (Miroslav and Vladimir, 1999). But the consumption of these samples should be with caution so, as to avoid leads deposition in the body which may be detrimental to health.

Lead is a poisonous metal that can damage nervous connection especially in young children it 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). In adult it damage brain, kidney and ultimately cause death while in pregnant women it cause miscarriage (Niosh, 2007).

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 *et al*., 1995).

Oxalate is a concern because of its negative effect on mineral availability, presence of oxalate in food causes irritation in the mouth (Onyeike and Omubo-Dede, 2002) and interfere with absorption of divalent minerals particularly Calcium by forming insoluble salts with them (Guil and Isasa, 1997). High oxalate diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stones (Chai and Liebman, 2004). The level of oxalate in the samples is not high to pose any health treat.

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).

Consumption of high levels of Cyanide is associated with a serious health problem, a neurological disease known as Tropical Ataxis Neuropathy (TAN) was linked to consumption of high level of Cyanide in cassava based diet (Hassan and Umar, 2004).

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 ratio were calculated so as to be able to predict the bioavailability of some divalent elements (i.e Ca, Mg, Fe and Zn). It was found that [Oxalate]/[Ca] ratio in the pulp (0.22) and [Oxalate]/(Ca+ Mg] ratio (0.04) is below the critical level of 2.5 at which it impaired Calcium bioavailability (Umar, 2005). Thus it indicate that the consumption of these 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 of the pulp is below the critical level of 0.2 like-wise the ratio of [Phytate]/[Zn] (0.24), 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 pulp had [Ca][Phytate][Zn] ratio of (0.02) which are below the critical level of 0.5, this shows that the bioavailability of Zn may not be hinder by the

Phytate content of the pulp of *G. aqualla* fruit. But the [Phytate][Fe] and [Phytate][Ca] ratio in the fruit pulp have reach the critical level this indicate that the consumption of the fruit pulp can hinder Iron and Calcium bioavailability in it. Therefore some Iron and Calcium enhancing food needs to be taken so as be able to meet the body requirement of these important minerals.

Conclusion: In conclusion, the result of this study showed that the fruit is a good source of carbohydrate and some minerals which are expected to speed up metabolic processes, improve growth and development. The fruit has high moisture content which means it cannot withstand microbial attack compared to those fruits with lower moisture content. The fruit pulp have low content of antinutritive factor, the predicted mineral bioavailability shows adequacy in terms of magnesium and zinc while in terms of calcium and iron some enhancers needs to be administered.

REFERENCES

Adekunle, V.A.J. and O.V. Ogerinde, 2004. Food potential of some indigenous wild fruit in lowland rainforests ecosystem of South West Nigeria. J. Food Technol., 2: 125-130.

Adewusi, S.R.A., A.J. Udio and B.A. Osuntogun, 1995. Studies on the carbohydrate content of bread fruit (*Artocarpus Communis forst*) from south-western Nigeria. Starch Nutr., 85: 285-294.

Adeyeye, E.I., 2002. Determination of the chemical composition of the nutritionally valuable parts of male and female common West African fresh water crab (*Sudananoutes africanus*). Int. J. Food Sci. Nutr., 53: 189-196.

Ahmed, U. and U.A. Birnin-Yauri, 2008. Comparative analysis of the nutrient composition of cashew (*Anarcadium occidentable*) apple and nut. Nig. J. Basic Applied Sci., 16: 87-89.

Anhwange, B.A., V.O. Ajibola and S.J. Oniye, 2004. Chemical studies of the seeds of *Moring oleifeira* and *Deuterium micrcarpum*. J. Bio. Sci., 4: 711-715.

AOAC, 1990. Official methods of analysis (15th Edn.). Washington D.C USA. Association of Official Analytical Chemists inch. 400-2200 Wilson Boalevard, Arlinton Virginia USA., 2: 910-928.

Appel, L.J., 1999. Nonpharmacologic therapies that reduce blood pressure. A fresh perspective. Clin. Cadiol., pp: 1111-1115.

Arinanthan, V., V.R. Mohan and A.J. Britto, 2003. Chemical composition of certain tribal pulses in South India. Int. J. Food Sci. Nutr., 3: 103-107.

Asaolu, M.F. and S.S. Asaolu, 2002. Proximate and mineral composition of cooked and uncooked *Solanum melongena*. Int. J. Food Sci. Nutr., 3: 103-107.

Barminas, J.D., M. Charles and D. Emmanuel, 1998. Mineral composition of non-conventional leafy vegetables. Plant Foods Human Nutr., 53: 29-36.

Baumer, M., 1995. Food Producing trees and Shrups of West Africa. Serie-Etudes-et Recheerches, Senegal, pp: 168-260.

Bello, M.O., O.S. Farade, S.R.A. Adewusi and N.O. Olawore, 2008. Studies of some lesser known Nigerian fruits. Afr. J. Biotechnol., 7: 3972-3979.

Cabrera, C.O., M.L. Lorenzo, C. DcNena and M.C. Lopez, 1996. Chromium, copper, iron, manganese, selenium and zinc levels in diary products: *In vitro* study of absorbable fractions. Int. J. Food Sci. Nutr., 47: 331-338.

Chai, W. and M. Liebman, 2004. Assessment of oxalate absorption from almonds and black beans with and without the use of an extrinsic label. J. Urol., 172: 953-957.

Elemo, B.O., G.N. Elemo, O.O. Oladimeji and Y.O. Komolafe, 2002. Studies on the composition of some nutrients and anti nutrients of sheanut (*Butyrospernum parkii*). Nig. Food J., 20: 69-73.

Eromosele, I.C., C.O. Eromosele and D.M. Kuzhkuzha, 1991. Evaluation of mineral elements and ascorbic acid contents in fruits of some wild plants. Plant Food Human Nutr., 41: 53-57.

Eromosele, I.O. and C.K. Eromosele, 1991. Evaluation of mineral elements and ascorbic acid contents in fruits of some wild plants. Plant Human Nutr., 41: 151-154.

Gordon, M.N. and M. Kessel, 2002. Perspective in Nutrition. McGraw Hill Company, Ohio, New York, 5th Edn., pp: 257-281.

Guil, J.L. and M.E.T. Isasa, 1997. Nutritional composition of leaves of *Chenopodium* species. Int. J. Food Sci. Nutr., 48: 321-327.

Hassan, L.G., S.M. Dangoggo, K.J. Umar, I. Saidu and F.A. Folorunsho, 2008. Proximate, minerals and anti-nutritional factors of *Daniellia oliveri* seed kernel. Chemclass J., 5: 31-36.

Hassan, L.G. and K.J. Umar, 2004. Proximate and mineral composition of seeds and pulp of African locust bean (*Parkia biglobosa*). Nig. J. Basic Applied Sci., 13: 15-27.

Hassan, L.G., K.J. Umar, S.M. Dangoggo and A.S. Maigandi, 2011. Anti-nutrient composition and bioavailability prediction as exemplified by calcium, iron and zinc in *Melocia corchorifolia* leaves. Pak. J. Nutr., 10: 23-24.

IITA, 1988. Selected methods for Soil and Plant Analysis (Manual series No.1) International Institute for Tropical Agriculture, Ibadan, Nigeria, pp: 55-56.

Kim-Shapiro, D.B., M.T. Gladwin, R.P. Patel and N. Hogg, 2005. Role of nitrite in haemoglobin-mediated hypoxic vasodilation. J. Inorganic Biochem., 99: 237-246.

Kotas, J. and Z. Stasiscka, 2000. Chromium occurrence in the environment and methods of its speciation. Environ. Pollut., 107: 263-284.

Krisna, G. and S.K. Ranjhan, 1980. Laboratory Manual for Nutrition Research, Vikas Publishing House PVT Ltd. Ghaziabad, UP (India).

Ladan, M.J., L.S. Bilbis and M. Lawal, 1997. Nutrient composition of some green leafy vegetables consumed in Sokoto. Nig. J. Basic Applied Sci., 5: 39-44.

Lin-Fu, J.S., 1976. Proceedings of the International Conference on Heavy Metals in Environment, Toronto, 27-31 October 1975. Electric Power Research Institute (Califonia).

Margaret, L. and B. Vickery, 1997. Plant Products of Tropical Africa. Macmillan in College ed. London.

McDonald, R.A. Edwards, F.D. Greenhalgh and C.A. Morgan, 1995. Animal Nutriton. Prentices Hall, London, pp: 101-122.

Melaku, G., 2005. Development of molecular marker for pro vitamin A Carotenoid (pVAC) genes in cassava. Abstract submitted tolSTRC-AB 11th symposium, Kinshasa.

Mielcarz, G.W. and A.N. Howard and N.R. Williams, G.D. Kinsman, E. Moriguchi, Y. Moriguchi and S. Mizushima and Y. Yamori, 1997. Copper and zinc status as a risk factor for ischemic heart disease: A comparison between Japanese in Brazil and Okinawa. J. Trace Elem. Exp. Med., 10: 29 - 35.

Miroslav, R. and N.B. Vladimir, 1999. Practical Environmental Analysis. Royal Society Chemistry, U.K 2. 263-273 and 357-377.

Niosh, A., 2007. The long term effect of exposure to low doses of lead in childhood. United States National Institute for Occupational Safety and Health. [online]. [Retrieved 2009 Nov. 13, 4: pm] Available: http// www.cdc.gov/niosh/topics/ables-descriptions.html.

NRC, 1989. National Research Council. Recommended Dietary Allowance, National Academy press, Washington DC.

Oluyemi, E.A., A.A. Akilua, A.A. Adenuya and M.B. Adebayo, 2006. Mineral contents of some commonly consumed Nigerian foods. Sci. Focus, 11: 153-157.

Omorayi, F.O. and L. Dilworth, 2007. Anti-nutritional factors, zinc, iron and calcium in some cariggean tuber crops and effect of boiling or roasting. Nutr. Food Sci., 37: 8-15.

Onyeike, E.N. and T.T. Omubo-Dede, 2002. Effect of heat treatment on the proximate composition, energy values and levels of some toxicants in African yam bean (*Sphenostylis stenocarpo*) seed varieties. Plant Foods Human Nutr., 57: 223-231.

Thompson, L.U., 1993. Potential health benefits and problems associated with anti nutrients in foods. Int. J. Food Resour., 26: 131-149.

Umar, K.J., 2005. Proximate Analysis of Seeds and Pulp of African Locust Bean. M.Sc. Dissertation Usmanu Danfodiyo University Sokoto (Unpublished), pp: 4-90.