International Food Research Journal 21(4): 1603-1607 (2014)
Journal homepage: *http://www.ifrj.upm.edu.my*

Proximate composition and micronutrient potentials of *Dialium guineense* wild growing in Benin

[1,2]Gnansounou, S. M., [1]Noudogbessi, J. P., [1]Yehouenou, B., [1]Gbaguidi, A. N. M., [1]Dovonon, L., [1]Aina, M. P., [2]Ahissou, H. and [1*]Sohounhloue, D.

[1]LERCA, Polytechnic School of Abomey-Calavi, University of Abomey-Calavi, Benin
[2]Department of Biochemistry and Molecular Biology, Faculty of Sciences and Technology, University of Abomey-Calavi, Benin

Article history

Received: 2 November 2013
Received in revised form: 29 January 2014
Accepted: 31 January 2014

Keywords

Dialium guineense wild
Nutrients
Minerals
Bio-molecules
Ascorbic acid
Pulp
Dietetic

Abstract

Dialium guineense wild is a tree growing exclusively in tropical Africa. Fruits from this tree are consumed by populations since many centuries. So it takes part to satisfy their nutritional needs and display an historical role as nutrients provider. Nutrient composition of the fresh fruit pulps was determined using standard methods of AOAC and those of European norms. Like the other fruits, it emerges that the fruit pulp is rich in minerals with interesting values for iodine (04.34 ± 0.12 mg/100 g), iron (14.75 ± 0.25 mg/100 g), calcium (70.14 ± 10 mg/100 g) and potassium (366 ± 0.26 mg/100 g). Bio-molecules analyzes have shown a high content in total carbohydrates (80 ± 1.8 g/100 g) and crud lipid (09.21 ± 0.50 g/100 g).Crud proteins content is (6.12 ± 0.33 g/100 g). Ascorbic acid was found in the pulp (4.5 ± 0.01 mg/100 g) with 9.36 ± 1.36 g/100 g moisture content. This investigation sought to provide data on the fruit pulp composition for judicious dietetic and socio-economic uses.

Introduction

According to FAO's evaluations, close to 870 millions people were underfed in 2010-2012 (FAO, 2012).The malnutrition by deficiency in micronutrients ("hidden hunger") that touches about 2 billions of people (either more than 30% of the world population), has heavy consequences concerning public health. Minerals particularly have a prime importance in human body metabolism so their deficiency or excess are both harmful (Hashmi *et al.*, 2007). Fruits are known as excellent source of mineral and vitamins (Nahar *et al.*, 1990) and may permit to increase rural population food quality (Kunhlein, 1989). *Dialium guineense* with English name velvet tamarind or black velvet is one of the most consumed wild fruit in tropical Africa. The tree grows to about 20 at 30 m in height, low-branching, rarely straight, bearing a compact densely leafy crown but is often shrubby (Okegbile and Taiwo, 1990; Akoègninou 2006). In Benin, the plant is called "assonswen''among the Fon and "awin'' by Yorubas. The fruit pulp is red with astringent flavour and is eaten raw when dry by man and animals (Matsuda, 2006). Some works have been reported on the fruit in Nigeria (Achoba *et al.*, 1992; Arogba *et al.*, 1994; Ubbaonu *et al*., 2005; Adepoju, 2009) and Ghana (Ofosu *et al*., 2013).There is limited or no information in the literature about the proximate composition of *Dialium guineense* wild growing in Benin where this plant is endangered (Meregini, 2005). It is therefore the aim of this study to corroborate its historic nutrient provider role by chemical analyzes in view to widen rural populace mineral source and preserve the plant.

Material and Methods

Sample collection and identification

The fruits of *Dialium guineense* have been harvested at the stage of maturity in Tankpè, Akassato and Glo from January to March 2013 while ripe fruits were available. Several samplings have been made to some weeks of interval. Samples from these three localities were submitted to the same analyzes in view to compare their results. Voucher specimen was deposited at the Benin National Herbarium for reference under the number AA 6462 / HNB. They have been kept at the laboratory in a dry aerated environment. Analyzes have been made on the pulp obtained before every manipulation by ridding the fruit of its coat and seed.

Chemical analyses

The fruit pulp from each locality has been analyzed in triplicate for moisture (AOAC 2003, Method: 950.46B), crude protein (AOAC 2003, Method: 990.03), crude lipid (AOAC 2003, Method: 920.39) and ash (AOAC 2003, Method: 942.05). Total carbohydrate was obtained using colorimetric

*Corresponding author.
Email: *ksohoun@bj.refer.org / csohoun@gmail.com*

method of Dubois *et al.* (1956) by adding phenol and sulfuric acid and readings taken on jenway RS 252 spectrophotometer. After calcination in a Nabertherm C 290 furnace (600°C) in crucibles made of china, the ashes have been diluted in hydrochloric acid (3 mol/l). Sodium and potassium have been measured out by spectrometry of flame with a Varian SpectrAA-110 apparatus. The measures have been preceded of cesium chloride's (5%) addition. They took place respectively under steam-powered lamp of sodium or potassium and were compared with absorption of standards of these minerals. A molecular absorption spectrophotometer portable HACH DR /2400 permitted readings at 240 nm and 265 nm of the contents in total iodine and total iron respectively. DPD Total iodine reagent cat 14064-99 lot A 0257 from HACH PRMACHEM USA was added 3 minutes before iodine's measure. Ferrover reagent lot A 1159 from HACH PERMACHEM has been used for iron measure. Complexometry with EDTA (Ethylene Diamine Tetra acetic Acid) served for dosage of calcium (NF T 90-016, August 1984) and magnesium (NF T 90-003, August 1984). Indicators of calcium ions (calver cat 917-99 lot A O313 HACH PERMACHEM USA) and magnesium (black eriochrome T) permitted to follow the reaction. Vitamin C in the pulp was determined by reverse titration with sodium thiosulphate and iodine using thiodene as indicator.

Statistical analysis

Data from three independent replicate trials were subjected to statistical analysis using Statistica version 6.0. Differences between means were tested using Z-test.

Results and Discussion

The mean elemental composition of the fruit pulp showed presence of calcium, sodium, magnesium, iron, iodine and potassium in varying quantities (Table 1 and 2). Because of the proximity of these localities, a great difference doesn't appear in the fruits composition. However, the fruits reaped at Tankpè contained the most elevated values for iron and sodium while those of Akassato had the best contents in iodine and potassium. Calcium, magnesium and vitamin C levels were higher in samples from Glo. Phosphorus, zinc, manganese and copper contents were reported to be low (Adepoju, 2009).The same work showed that Dialium guineense had low moisture because it becomes dry during maturation.

Some considerable variations occur in food composition because of their biologic origin. These variations are the fact of endogenous factors (degree of maturity, genetic influence) or exogenous ones like temperature, sunshine and nature of soils (Paul and Southgate, 1988). However, despite a divergence of water and minerals contents, our results were globally in agreement with those published by Adepoju (2009) and Ofosu (2013) on Nigeria's *Dialium guineense* and those of Ghana. Obviously, with 09.36% of moisture, median value between those reported (04% - 17.1%) (Arogba *et al*., 1994; Ubbaonu *et al.*, 2005; Adepoju, 2009), the pulp of the studied fruit here couldn't be considered as refreshing in comparison with those consumed fluently (mangoes, oranges, pineapple, bananas).

Table 1. Minerals and vitamin C composition of Dialium guineense (D. g.) growing in Akassato,Glo and Tankpè

	D.g. of Akassato	D.g. of Glo	*D.g.* of Tankpè
Vitamin C [mg]	04.3±0.04b	04.6±0.02a	04.6±0.00a
Calcium [mg]	60.12±11a	80.16±12b	70.14±8c
Magnesium [mg]	25.20± 5a	36.42± 6.5a	30.90± 5.3a
Iron [mg]	14.80± 0.35a	14.35±0.2a	15.10± 0.2a
Iodine [mg]	04.50± 0.15a	04.25±0.12 a	04.34± 0.1 a
Sodium [mg]	75.10±0.04 a	76.00±0.16 a	76.92±0.07 b
Potassium [mg]	368.11±0.23 b	364.98±0.25 a	364.91±0.3 a

*n = average of three independent samples, analyzed in triplicate. Means in the same line followed by different letters are significantly different ($p < 0.05$)

In spite of the relatively weak value of crud proteins contained in the pulp (06.12%), the fruits of *Dialium guineense* are richer in proteins than the wild berries from British Colombia (Kuhnlein,1989), orange, strawberry and melon (Anon, 1960). This fruit therefore wear a particular aspect because fruits are generally not considered like sources of proteins (Edem *et al.*, 1984; Ishola *et al.*, 1990). This value was within the range (8.3% and 6.3%) stated in literature (Arogba *et al.*, 1994; Adepoju, 2009).

The high level of total sugars (80%) was in the range of the values published early and explains the fruit sweetened taste. The sugars measured out here regrouped digestible carbohydrates as well as the food fibers little or nearly not energizing. A weak rate of these fibers (0.6%) being returned by Adepoju, the quasi-totality of sugars would then be digestible. The fruit is therefore indicated for children and people with hypoglycemia. The diabetics, on the other hand, should avoid some or limit the consumption (Table 3 and 4).

Vitamin C content of the pulp was close to those (1.8 - 6.2 mg/100 g) returned in the literature (Wu Leung, 1968; Eremosele, 1991). It places the fruit of *D. guineense* to the rank of good sources of vitamin C and its consumption can contribute to satisfy the journal requirement that is 90 to110 mg (Marieb, 1999). The importance of this vitamin resides otherwise in its antioxidant power (Vodjani *et al*., 2000; Laight *et al*., 2000; Masaki *et al.*, 2010) inhibiting the ominous effect of free radicals on the DNA. It is indispensable for iron absorption; cloves repair and blood vessels

Table 2. Average of vitamin C and minerals of D.g. growing in Benin

Dialium guineense wild growing in Benin	
Vitamin C [mg]	04.5±(0.01)
Iodine	04.34±0.12
Iron	14.75±0.25
Magnesium	30.84±(5.6)
Calcium [mg]	70.14 ±(10)
Potassium	366±0.26

Table 3. Proximate composition of *D. guineense* growing in Akassato, Glo and Tankpè (g /100 g edible portion of fruit pulp)*

	D.g. of Akassato	D.g. of Glo	*D.g.* of Tankpè
Moisture	7.17± 1.4b	11.13 ± 1.38a	09.8±1.6 a
Ashes	1.5 ±0.04 a	1.72 ±0.05 b	1.89±0.06c
Total carbohydrate [g]	78.4 ±3 a	81±1 a	79.7±1.4 a
Crude Lipids [g]	8.66 ±0.4 a	9.66±0.2 a	09.33±0.30a
Crude Proteines [g]	6.17 ± 0.46 a	5.77 ± 0.3 a	06.43±0.23 a

*n = average of three independent samples, analyzed in triplicate. Means in the same line followed by different letters are significantly different ($p < 0.05$)

Table 4. Average of ashes, moisture and bio-molecules of D.g. growing in Benin

Dialium guineense wild growing in Benin	
Mosture	09.36±1.36
Ashes	01.70±0.05
Total carbohydrate	80±1.8
crude lipid	09.21±0.50
Crude protein	06.12±0.33

formation via collagen synthesis. Several works established its beneficial action in the treatment or prevention of rheumatism, type 2 diabetes (Canter *et al*., 2007; Afkhami-Ardekani *et al.*, 2007) and of the cardiovascular illnesses (Cook *et al*., 2007; Shinke *et al.*, 2007). A food poor in C vitamin is associated to fatigue (Suh *et al*., 2012) and immunodeficiency (Harakesh *et al*., 1990).

The pulp had interesting contents in calcium and magnesium but lower than to those of the literature (Adepoju, 2009; Ofosu, 2013). Calcium participates to ossification, to the muscular contraction and to the blood coagulation (Wardlaw *et al*., 2012). As for magnesium, it cooperates with calcium to the muscular contraction and blood coagulation. It is a cofactor for several enzymes (Rude *et al*., 2010). A magnesium deficiency conducted to neurological or neuromuscular disorder (Shils *et al*., 1988).

Iron content was 14.75 ± 0.25 mg/100 g.This value three times superior to the one found by Adepoju makes of the fruit a good means of preventive struggle against anemia. The pulp iron absorption is more efficient because of the presence of vitamin C (Derman *et al*., 1980; Halberg *et al*., 1987; Siegenberg *et al*., 1991; Cook *et al.*, 1977). In spite of its major biologic role, few values appear in the literature about the pulp iodine content. The value found in the present survey is 04.34 ± 0.12 mg /100 gs of pulp. Iodine deficiency leads to physiological mess with trouble of cerebral functions (Benmiloud *et al*., 1983; Hetzel *et al*., 1983; Delange *et al*., 1994; Fischer *et al*., 1998).

The values obtained for sodium and potassium were respectively 76 ± 0.09 and 366 ± 0.26 mg/100 g. They were in agreement with those of the literature. The effects of potassium against the arterial hypertension were reported (Ophir *et al*., 1987; Siani *et al*., 1987; Girmin *et al.*, 1990; Young *et al*., 1995; Whleton *et al*., 1997; Suter, 1998). Besides the endogenous and exogenous biologic conditions that could explain the divergences of contents of our samples with those of the Nigeria and Ghana, the methods of analyses used influenced by their sharpness on the different results.

Conclusion

The abundant presence of sugars in the pulp of *Dialium guineense* fruits makes of it a good supplier of this nutriment quickly usable by cells. Its high contents in major minerals (calcium, sodium, magnesium, potassium) as well as that in minor minerals (iodine, iron) open the way for use in order to palliate mineral deficiency problems. Diabetics and obese should avoid this fruit while children and pregnant women need some.

Acknowledgements

The authors are grateful to Polytechnic School of Abomey-Calavi for financial support of this work. They are also thankful to Doctor Philippe SESSOU for his scientific contribution.

References

Achoba , I. I., Choba , J. A., Lori, J. A., Elegbede, J. A. and Kagbu, J. A.1992. Nutrient composition of black (African) velvet tamarind seed and pulp from Nigeria. Journal of Food Biochemistry 16(4):229-233.

Adepoju, O. T. 2009. Proximate composition and micronutrient potentials of three locally available wild fruits in Nigeria. African Journal of Agricultural Research 4(9): 887-892.

Afkhami-Ardekani, M. and Shojaoddiny-Ardekani, A. 2007. Effect of vitamin C on blood glucose, serum lipids and serum insulin in type 2 diabetes patients. Indian Journal of Medical Research 126 (5): 471-4.

Akoègninou, A., van der Burg, W. J. and van der Maesen, L. J. G.2006. Flore analytique du Benin. Cotonou and Leiden: Backhuys Publisher.

Anon.1960.Food composition tables. Rome: FAO.

AOAC. 2003. Official Methods of analysis of AOAC.17th edn. Arlington, VA: Association of Official Analytical Chemists (AOAC) International.

Arogba, S. S, Ajiboro, A. and Odukwe, I.1994.A physico-chemical study of Nigeria velvet Tamarind (*Dialium guineense*) fruit. Journal of the Science of Food and Agriculture 66(4): 533-534.

Benmiloud M., Bachtarzi H. and Chaouki M.B. (1983) Public health and nutritional aspects of endemic goitre and cretinism in Africa. In: Delange F. and Ahluwalia R. Cassava toxicity and thyroid. p.50. Research and Public Health Issues, IDRC, Ottawa.

Canter, P.H.,Wider, B. and Ernst, E. 2007. The antioxidant vitamins A, C, E and selenium in the treatment of arthritis: a systematic review of randomized clinical trials. Rheumatology (Oxford) 46(8): 1223-1233.

Cook, J. D. and Monsen, E. R.1977. Vitamin C, the common cold and iron absorption. American Journal of Clinical Nutrition 30 (2): 235-241.

Cook, N. R., Albert, C. M., Gaziano, J. M., Zaharris, E., MacFadyen, J., Danielson, E., Buring, J. E. and Manson, J. E.2007. A randomized factorial trial of vitamins C and E and beta carotene in the secondary prevention of cardiovascular events in women: results from the Women's Antioxidant Cardiovascular Study. Archives of Internal Medecine 167(15): 1610-8.

Delange, F. 1994. The disorders induced by iodine deficiency. Thyroid 4 (1): 107-128.

Derman, D. P. 1980.Importance of ascorbic acid in the absorption of iron from infant foods. Scandinavian Journal of Haematology 25 (3): 193-201.

Dubois, M.,Gilles, D. A., Hamilton, J. K., Rebers, P. A. and Smith, F. 1956. Colorimetric methods for determination of sugar and related substances. Analytical Chemistry 28 (3): 350-356.

Edem, D. O, Eka O.U. and Ifon, E.T.1984. Chemical Evaluation of the Value of the fruit of African Star apple (*Chrisysophyllum albidum*). Food chemistry 14: 303-311.

Eremosele,I. C., Eremosele, C. O., and Kuzhkuzha, D. M. 1991. Evaluation of mineral element and ascorbic acid contents in fruits of some wild plants. Plant Foods for human Nutrition41(2): 151-154.

FAO. 2012. The state of food insecurity in the world. Rome, ITALY.

Fisher, D. A. and Delange, F. M.1998.Thyroid hormone and iodine requirements in man during brain development. In: Iodine in Pregnancy. Stanbury, J. B., Delange, F., Dunn, J. T., and Pandav, C. S.editors. New Delhi, Oxford University Press Publication.

Grimm, R. H., Neaton, J. D. and Elmer, P. J.1990.The influence of oral potassium chloride on blood pressure on hypertensive men on a low sodium diet. New England Journal of Medecine 322(9): 569-574.

Hallberg, L., Brune, M.and Rossander-Hultén, L. S. 1987. Is there a physiological role of vitamin C in iron absorption? Annals of the New York Academy of Sciences 498(1): 324-332.

Harakeh, S., Jariwalla, R. and Pauling, L. 1990. Suppression of human immunodeficiency virus replication by ascorbate in chronically and acutely infected cells. Proceedings of the National Academy of Sciences USA 87(18): 7245-7249.

Hashmi, D. R., Ismail, S.and Shaikh, G. H. 2007. Assessment of the level of trace metals in commonly edible vegetables locally available in the markets of Karachi city. Pakistan Journal of Botany 39(3): 747-751.

Hetzel, B. S.1983. Iodine deficiency disorders (IDD) and their eradication. Lancet. 322 (8359): 1126-1129.

Ishola , M.M., Agbadji, E. B. and Agbadji, A. S. 1990. A chemical study of *Tamarindus indica* (Tsamiya) fruits grow in Nigeria. Journal of the Science of Food and Agriculture 51(1): 141-143.

Kuhnlein, H.V. 1989. Nutrient values in indigenous wild berries used by the Nuxalk people of Bela Coola, British Colombia. Journal of Food Composition and Analysis 2:28-36

Laight, D. W., Carrier, M. J., Anggard, E. E. 2000. Antioxidants, diabetes and endothelial dysfunction. Cardiovascular Research 47: 457-464

Marieb E. N. 1999. Anatomie et Physiologie Humaines (Traduction de la 4e édition américaine) Editions du Renouveau Pédagogique inc. ISBN DBU 2 -8041 -3219-6.

Masaki, H.2010. Role of antioxidants in the skin:anti-aging effects. Journal of Dermatological Science 58(2):85-90.DOI 101016.

Matsuda, R.2006. Feeding ecology of the Mona monkey (*Cercopithecus mona*) in a seasonally dry flooded forest in the Dahomey gap. Dept. of Anthropology, Graduate Center, City University of New York, New York, NY, 10016, (USA IPS Conference 2006 (Abstracts).

Meregini, A. O.2005. Some endangered plants producing edible fruits and seed in southeastern Nigeria. Fruit 60: 211-220.

Nahar, N., Rahman, S. and Mosiihuzzaman, M.1990. Analysis of carbohydrates in seven edible fruit of Bengladesh. Journal of Science of Food and Agriculture 51:185-192.

Ofosu, D. O., Opata, N. S., Gyampo, O. and Odamtten, G.T. 2013. Research Journal of Applied Sciences, Engineering and Technology 6(19): 3536-3539.

Okegbile, E. O. and Taiwo, E. O. 1990. Nutritional potentials of velvet tamarind (*Dialium guineense* Wild). Nigerian Food Journal 8: 115-121.

Ophir, O., Peer, G. and Gilad, J. 1983. Low blood pressure in vegetarians: the possible role of potassium. American Journal of Clinical Nutrition 37: 755-762.

Paul, A. A. and Southgate, D. A. T. 1988. The composition of foods. McCance and Widdowson. Elsevier, North Holland Biomedical Press, London, 418pp.

Rude, R. K. 2010. Magnesium. Encyclopedia of Dietary Supplements 2nd ed. New York, Informa Healthcare.527- 537.

Shils, M. E. 1988. Magesium in health and disease. Annual Review of Nutrition 8: 429-460.

Shinke, T., Shite, J., Takaoka, H., Hata, K., Inoue, N., Yoshikawa, R., Matsumoto, H., Masai, H., Watanabe, S., Ozawa, T., Otake, H., Matsumoto, D., Hirata, K. and Yokoyama, M. 2007. Vitamin C restores the contractile response to dobutamine and improves myocardial efficiency in patients with HF. American Heart Journal 154(4): 645.

Siani, A., Stazullo, P. and Russo l. 1987.Controlled trial of long-term oral potassium supplements in patients

with mild hypertension. British Medical Journal 294 (6585): 1453-1456.

Siegenberg, D. 1991 Ascorbic acid prevents the dose-dependent inhibitory effects of polyphenols and phytates on non heme-iron absorption. American Journal of Clinical Nutrition 53 (2): 537-541.

Suh, S. Y., Bae, W. K., Ahn, H. Y., Choi, S. E., Jung, G. C. and Yeom, C. H. 2012. Intravenous Vitamin C administration reduces fatigue in office workers: a double-blind randomized controlled trial. Nutrition Journal 11: 7

Suter, P. 1998. Potassium and hypertension. Nutrition Reviews 56 (5):151-153.

Ubbaonu, C. N., Onuegbo, N. C., Banigo, E. O. I. and Uzoma, A.2005. Physico-chemical changes in velvet tamarind (*Dialium guineense* wild) during fruit development and ripening. Nigerian Food Journal 23:133-138.

Vojdani, A., Bazargan, M., Vojdani, E. and Wright, J. 2000. New evidence for antioxidant properties of vitamin C. Cancer Detection and Prevention 24(6): 508-23.

Wardlaw, G., Smith, A.2012. Contemporary Nutrition, a functional approach. 3rd edn.Publisher: Mc Graw-Hiller Science /Engenering/ Math.

Whleton, P. K. and Cutler, J. A. 1997. Effects of oral potassium on blood presure: meta-analysis of randomized controled clinical trials. Journal of American Medical Association 277(20): 1624-1632.

Wu, L. 1968. Food composition table for use in Africa. FAO, Rome, Italy.

Young, D.B., Lin H. and McCabe R. D.1995. Potassium's cardiovascular protective mechanism. American Journal of Physiology 268(4 pt 2): 835-837.