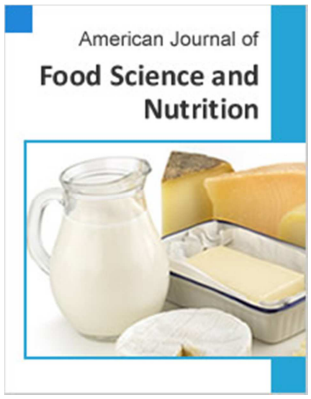
American Journal of Food Science and Nutrition
2017; 4(6): 80-84
http://www.aascit.org/journal/ajfsn
ISSN: 2375-3935

AASCIT American Association for Science and Technology



Keywords
Proximate Composition,
Fatty Acids Profiles,
Cola Nuts,
Cola Nitida,
Cola Acuminata,
Garcinia Kola

Received: May 16, 2017
Accepted: September 8, 2017
Published: October 17, 2017

Comparative Study of the Proximate and Fatty Acid Profiles of Cola Nitida, Cola Acuminata and Garcinia Kola

Adeyeye Adeniyi*, Ayodele Olufunmilayo Deborah, Akinnuoye Gentle Akinnuoye

Department of Chemical Sciences, Oduduwa University, Ipetumodu, via Ile–Ife, Nigeria

Email address

niyade2002@yahoo.com (A. Adeniyi)

*Corresponding author

Citation

Adeyeye Adeniyi, Ayodele Olufunmilayo Deborah, Akinnuoye Gentle Akinnuoye. Comparative Study of the Proximate and Fatty Acid Profiles of Cola Nitida, Cola Acuminata and Garcinia Kola. *American Journal of Food Science and Nutrition.* Vol. 4, No. 6, 2017, pp. 80-84.

Abstract

Analyses of proximate compositions and fatty acid profiles of the three different kolanut species consumed in Nigeria (i. e. Cola nitida, Cola acuminata and Garcinia kola) obtained from Ipetumodu via Ile-Ife, Nigeria were carried out using standard analytical methods. The results for the proximate parameters ranged as follows: 12.85–15.20, 6.45–9.65, 8.40–10.75, 5.50–6.85, 2.15–2.60 and 58.25–68.55% for moisture, crude protein, crude fat, crude fibre, ash and carbohydrate contents respectively. The unsaturated fatty acids predominated over the saturated ones. The total unsaturated fatty acids ranged from 68.55% in C. nitida through 69.14% in C. acuminata to 74.26% in G. kola, while the saturated fatty acids ranged from 25.74% in G. kola through 30.86% in C. nitida to 31.45% in C. acuminata. All the three cola species were rich in essential fatty acids, these being most abundant in G. kola (45.44%), followed by C. acuminata (42.76%) and least in C. nitida (41.24%). The total unsaturated/saturated (or P/S) ratio was highest in G. kola, making it to be the most nutritionally useful of them all.

1. Introduction

Kolanut belongs to the plant family Sterculiaceae, having about 125 species of trees native to the tropical rainforests of Africa [1]. Of these, two species are particularly very common among the people of Southern Nigeria. These are Cola acuminata (called obi abata) and Cola nitida (called obi gbanja), both local names in Yoruba language. Kolanut is chewed in many West African cultures, either individually or in group settings and is often used ceremonially. Kolanut is used as a masticatory stimulant by Africans and has numerous uses in social, religious and cultural functions by natives in the forest region of Africa. In southern Nigeria, the nut is served to visitors as a symbol of hospitality, kindness and fraternity. It is used during ceremonies related to marriage, child naming, freedom from apprenticeship, installation of chiefs, funeral and many other services. Kolanuts contain large amounts of caffeine and threobromine and are therefore used as stimulants [2]. They produce a strong state of euphoria and well-being, enhance alertness and physical energy, elevate mood, increase tactile sensitivity, suppress appetite and hunger and are used as an aphrodisiac. It is for these reasons that kolanut chewing has become very popular among students, drivers and many others who need to remain active for unusually long period [2]. The caffeine in the nut also acts as a bronchodilator,

expanding the bronchial air passages. Hence kolanuts are often used to treat whooping cough and asthma. In addition, caffeine is known to be a fat burner and therefore to be beneficial in assisting weight loss [3].

About 90% of the kolanuts produced in Nigeria is consumed in the country while the remaining 10% is exported fresh or as sun-dried nuts to other parts of Africa especially neighbouring West African countries where they are used as stimulants or as sources of colorants for cloth dyeing [4; 5]. C. acuminata is frequently used for social and religious ceremonies in Southern and Middle-belt Nigeria while C. nitida which is referred to as "the true kola of commerce" has featured in the internal trade of West Africa for a number of centuries [2]. The nuts are the cotyledonous seeds in which the purplish, cartilaginous testa has been removed. The irregular seeds, due to close nesting in the follicle have a compressed triangular shape with a bitter astringent taste when wet and a faintly aromatic taste when dry.

There are three varieties of kolanuts i. e. white, pink and red, the most predominant being the red variety, while the white variety is the least common. The three varieties are normally produced by the same species and often occurring in the same pod. Kolanuts are a common sight in the markets of African villages and cities where they are sold by street vendors at bus stops and train depots. They also have industrial usage for the production of drugs, soft drinks, wines, candies and beverages [2; 4]. These species are sources of caffeine in processing and pharmaceutical industries. The presence of other chemicals in kola nuts such as kolanin and theobromine also makes them suitable for use in drug preparation [6; 7]. In addition, research has shown some potential uses of kolanut in the production of wine, chocolate and many non-alcoholic beverages [8].

Garcinia kola (bitter kola), also known as African wonder nut, belongs to the family guttiferae and has been recognized as a medicinal plant indigenous to, and cultivated throughout the coastal rain forest areas of Central and West Africa, most especially Nigeria. Its natural habitat is thus the subtropical or tropical moist lowland forests. Bitter kola is enjoyed by the three major ethnic groups in Nigeria (i.e. the Yorubas, the Igbos and the Hausas), from whom it derived the local names akuilu in Igbo, orogbo in Yoruba and namijin-goro in Hausa languages [9]. Garcinia kola is cultivated for its edible fruit and seeds which are used as rejuvenating agent for masticatory purposes and as a general antidote [10]. In the traditional Yoruba and Igbo cultures of southern Nigeria, it is presented to visitors as a sign of peace and welcome. Like kolanut, it is also used to entertain guests during ceremonies and festivities. Again, it is popularly used among various Nigerian groups for nervous alertness and induction of insomnia when chewed. Traditionally, the nuts of Garcinia kola are used as masticatory substance to stimulate the flow of saliva, but are also consumed as snack [11; 12]. It is believed to clean the digestive system, without side effects such as abdominal problems, even when a lot of it is eaten [13]. In traditional medicine, the dried nut is ground and mixed with honey to make a traditional cough mixture [1]. The ground nut may also be mixed with water and given to new born babies to relieve stomach cramps [14]. The nuts are chewed for aphrodisiac effect or used to cure cough, dysentery, chest cold, throat infections, bronchitis, hepatitis and liver disorders, osteoarthritis, etc. [15; 16].

Kola has a wide application in the food and pharmaceutical industries where it is used as a source of caffeine in foods and pharmaceutical products. The possible use of kolanut for the production of soft drinks has also been reported [2]. Kolanut also contains traces of essential minerals like K, Ca, Mg Na, Fe Zn, Mn, and P [1]. Some of these minerals act as sources of macro and micro nutrients needed for the growth, development and metabolic activities of man. With all the commercial trading activities of kolanuts and bitter cola in Nigeria and West Africa, not much research work has been done to elucidate the fatty acid contents of the seed oils. There is therefore a great need to look into the chemical contents and fatty acids profiles of their oils so as to further buttress and expose them for more commercial and industrial applications.

2. Materials and Methods

2.1. Sample Collection

Fresh samples of the seeds were purchased from Obada market, off Oduduwa University campus, Ipetumodu via Ile-Ife, Osun State, Nigeria, and were taken to the Biology Laboratory of the Institution for identification.

2.2. Proximate Analysis

Standard methods of the Association of Official Analytical Chemists [17] were used to determine the proximate composition of each sample, including moisture, crude fat, crude protein, crude fibre and total ash contents of the nuts. Moisture content of each sample was determined by oven drying of 5 g of sample to a constant weight at 105°C. Crude protein content was determined by Kjeldahl method using 6.25 as the conversion constant after the determination of its nitrogen. Crude fat content was determined by Soxhlet method using petroleum ether as solvent. The ash content was determined gravimetrically after ignition at 550°C. Carbohydrate content was calculated by difference. All analyses were carried out in triplicates.

2.3. Fatty Acids Determination

The fatty acids were converted to their esters and the esters analyzed using a PYE Unicam 304 gas chromatography fitted with a flame ionization detector and PYE Unicam computing integrator. Helium was used as carrier gas. The column initial temperature was 150°C rising at 5°C min-1 to a final temperature of 220°C. The injection port and detector temperatures were maintained at 220°C and 250°C respectively. The peaks were identified by comparison with

peaks of standard fatty acid methyl esters.

3. Results and Discussion

3.1. Proximate Composition

The moisture contents of the three kola species are as shown in Table 1. The values ranged from the lowest of 12.85% in C. nitida to the highest of 15.20% in G. kola. These are higher than those reported in Benin Republic for the three species with values ranging between 8.46% and 12.46% [18], and those reported in Nigeria by Dewole et al. [19] with values of 9.73% for C. acuminata, 9.81% for C. nitida and 7.2% for G. kola.

On the other hand, the values are lower than those reported by Ajai et al. [20] which values ranged between 20.62% and 22.50% for the three species, as well as those reported by Odebunmi et al. for C. nitida (66.40%) and G. cola (60.48%) respectively [1]. The variation in moisture contents observed from the different studies would be related to loss of weight during storage and transportation or season of evaluation since the studied samples were not obtained directly from the same tree. It may also be due to the location, soil, variety, maturity and the cultural practices adopted during planting [21]. No doubt the low moisture contents of the samples are good for their long preservation as this would prevent early spoilage of the nuts.

The protein contents ranged between 3.45% in G. kola and 5.00% in C. acuminata. These values are lower than those reported by some other authors including 10.06% for C. nitida, 10.64% for C. acuminata and 4.95% same tree. It may also be due to the location, soil, variety, maturity and the cultural practices adopted during planting [21]. The low moisture contents of the samples are good for their long preservation as this would prevent their early spoilage.

Table 1. *Proximate composition of Cola acuminata, Cola nitida and Garcinia kola seeds, (fresh weight basis).*

Parameter*	Cola acuminata %	Cola nitida %	Garcinia kola %
Moisture content	13.25±0.75	12.85±0.35	15.20±0.85
Crude protein	9.65±0.25	8.75±0.15	6.45±0.25
Crude fat	10.75±0.35	9.15±0.05	8.40±0.15
Crude fibre	5.50±0.15	6.45±0.25	6.85±0.20
Ash content	2.60±0.25	2.15±0.20	2.55±0.45
Carbohydrate content	58.25±1.55	60.65±1.65	68.55±1.45

*Average of three determinations.

The protein contents ranged between 3.45% in G. kola and 5.00% in C. acuminata. These values are lower than those reported by some other authors including 10.06% for C. nitida, 10.64% for C. acuminata and 4.95% for G. kola reported in Benin Republic by Dah-Nouvlessounon et al. [18], means of 15.4% and 13.38% for C. nitida and C. acuminata respectively reported by Atanda et al. [22], and also 39.52% reported for G. kola by Eleyinmi et al. [23]. They are comparable with 8.9% reported for C. nitida by Jaiyeola et al. [2] and also 8.68% for C. nitida and 8.65% for C. acuminata reported by Ajai et al. [20]. The values are however higher than the 1.86% reported for G. kola by Adesuyi et al. [9] and the 2.63% and 2.48% reported for C. nitida and G. kola by Odebunmi et al. [1]. The importance of protein in the human body cannot be over-emphasized. It is a source of amino acids in the diet of man and an essential food content without which our bodies would be unable to repair, regulate or protect itself. Essential body processes such as water balancing, nutrient transport and muscle contractions require protein to function properly, while it is also required for the formation of enzymes and hormones. It also aids in the formation of antibodies that enable the body to fight infection [24].

The fibre contents had a minimum value of 5.50% in C. acuminata and a maximum of 6.85% in G. kola. The values for C. nitida and C. acuminata are lower than those reported by Atanda et al. [22] with values of 10.70% for C. nitida and 9.68% for C. acuminata, but higher than the ones reported by Ajai et al. [20] with values of 3.38% and 4.25% for C. acuminata and C. nitida respectively. The fibre content in G kola is higher than 1.23% reported by Adesuyi et al. [9], 3.83% of Ajai et al. [20] and 5.23% of Odebunmi et al. [1]. Fibre is useful for maintaining bulk motility and increasing intestinal peristalsis by surface extension of the food in the intestinal tract. It is necessary for healthy condition, curing of nutritional disorders and for food digestion. Dietary fibre is also reported to lower the risk of coronary heart diseases [25].

The crude oil contents ranged from 8.40% in G. kola to 10.75% in C. acuminata. The values fall below those reported by Atanda et al. for C. nitida (11.90%) and C. acuminata (10.80%) [22], but are higher than those reported in Benin Republic by Dah-Nouvlessounon et al. with values of 3.00%, 3.50% and 2.00% for C. nitida, C. acuminata and G. kola respectively [18], and those of Ajai et al. with values of 0.87%, 0.80% and 0.90% for C. nitida, C. acuminata and G. kola respectively [20]. Fat is a source of energy for the body but excess of it leads to excessive weight gain and its consequent deleterious effects. Since the kolanuts serve as snacks and refreshments, the total fat from this source is small and may not be too detrimental to the consumer.

The ash contents, which measure the mineral contents of biological samples, ranged between 2.15% in C. nitida and 2.80% in C. acuminata. The values are comparable with those of Dewole et al. [19] with values of 2.27% for C. acuminata and 2.21% for C. nitida, and those of Ajai et al. [20] with values of 2.59%, 2.50% and 3.00% for C. nitida, C. acuminata and G. kola respectively. They are, however, higher than the values of Odebunmi et al. with values of 1.50%

and 0.79% for C. nitida and G. kola respectively [1], but lower than those of Atanda et al. with values of 4.00% for C. acuminata and 4.30% for C. nitida [22].

3.2. Fatty Acids Composition

The fatty acid profiles of the three kola species are shown in Table 2. The total saturated fatty acids ranged from 25.74% in G. kola to 31.45% in C. acuminata, while total unsaturation ranged between 68.55% in C. acuminata and 74.26% in G. kola. The main saturated fatty acids present are capric (C10:0), lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0) and arachidic (C20:0) acids. Stearic acid was the most abundant saturated fatty acid, ranging between 9.52% in G. kola and 16.40% in C. nitida, followed by palmitic acid with a range of 4.35% in C. nitida and 5.50% in G. kola. The most abundant unsaturated fatty acids were (i) oleic acid (C18:1) with values ranging between 22.94% in C. acuminata and 24.64% in C. nitida, (ii) linoleic acid (C18:2) with values ranging between 38.62% in C. nitida and 42.62% in G. kola, (iii) linolenic acid with values ranging between 2.62% in C. nitida and 3.97% in C. acuminata and (iv) arachidonic acid ranging from 2.20% in C. nitida to 3.68% in G. kola. In general all the kola species oils gave higher levels of total unsaturated fatty acids than saturated and the total unsaturated fatty acids amounted to 68.55% in C. acuminata, 69.14% in C. nitida and 74.26% in G. kola. Linoleic and linolenic acids, the essential fatty acids, which cannot be synthesized in the body and have to be supplied from food for their essential roles in the body, are of significant importance nutritionally. This is because they play a natural preventive role in cardiovascular diseases and promote the reduction of both total and high density lipoprotein cholesterol [26]. Inappropriate balance of essential fatty acids contributes to various kinds of malfunctioning while a proper balance maintains and even improves health [27]. There are good amounts of these essential fatty acids in the samples, making them to be beneficial to the consumer.

Table 2. *Percentage fatty acid compositions of Cola acuminata, Cola nitida and Garcinia kola seed oils.*

Fatty Acid %	Cola acuminata	Cola nitida	Garcinia kola
Caproic, C6:0	0.18	0.14	0.36
Caprylic, C8:0	0.82	0.12	0.84
Capric, C10:0	1.27	1.39	1.35
Lauric, C12:0	2.82	3.73	2.57
Myristic, C14:0	2.23	2.08	2.42
Palmitic, C16:0	5.25	4.35	5.50
Palmitoleic, C16:1	0.10	0.23	0.22
Margaric, C17:0	1.56	1.21	1.72
Stearic, C18:0	15.86	16.40	9.52
Oleic, C18:1	22.94	24.64	24.23
Linoleic, C18:2	38.79	38.62	42.62
Linolenic, C18:3	3.97	2.62	2.82
Arachidic, C20:0	1.26	1.15	1.08
Arachidonic, C20:4	2.39	2.20	3.68
Behenic, C22:0	0.10	0.17	0.06
Erucic, C22:1	0.36	0.83	0.69
Lignoceric, C24:0	0.10	0.17	0.34
Total saturated	31.45	30.86	25.74
Total unsaturated	68.55	69.14	74.26
Total mono-unsaturated	23.40	25.70	25.14
Total poly-unsaturated	45.15	43.44	49.12
Essential fatty acids	42.76	41.24	45.44
P/S index	1.436	1.408	1.911
Oleic/Linoleic ratio	0.591	0.638	0.569

The ratio of total unsaturated to total saturated fatty acids [TUSFA/TSFA or (P/S ratio)] ranged from 1.408 in C. nitida to 1.911 in G. kola. This ratio determines the detrimental effects of dietary fats. The higher the P/S ratio, the more nutritionally useful the oil is. This is because the severity of arteriosclerosis is closely associated with the proportion of the total energy supplied by saturated fats and polyunsaturated fats [28]. The values here obtained compared favourably well with values reported for some other plant seed oils [29]. The oleic/linoleic (O/L) ratio has to do with the stability and potentiality of the oil for deep frying [30]. The low values got for these oil samples may not be favourable for the purpose. The high percentage of polyunsaturated fatty acids in the oil samples may be an advantage as these fatty acids are essential in the diets of man. The presence of arachidonic acid is also of dietary importance as it serves as a precursor of prostaglandin and thromboxane biosynthesis [31].

4. Conclusion

This report gave the nutritional composition and fatty acid profiles of the three kola species available in Nigeria, including Cola nitida, Cola acuminata and Garcinia kola, and their importance to the consumers who use them as snacks. The nature and chemical characteristics of the fatty acid contents of the oils are also revealed. All the seed oils gave high levels of unsaturated fatty acids and especially high total

essential fatty acids contents, the least in Cola nitida being greater than 40%. Hence, they all have great nutritional potentials and add greater value to them as good food supplements.

References

[1] Odebunmi E. O., Oluwaniyi O. O., Awolola G. V., Adediji O. D. Proximate and nutritional composition of kola nut (Cola nitida), bitter cola (Garcinia cola) and alligator pepper (Afromomum melegueta). African J Biotechnol. 2009; 8 (2): 308–310.

[2] Jayeola C. O. Preliminary studies on the use of kolanut (Cola nitida) for soft drink production. J Fd Technol in Africa. 2001; 6 (1): 26–26.

[3] Blades M. Functional foods or neutraceutical. Nutri Fd Sci. 2000; 30 (2): 73–76.

[4] Ogutuga D. B. A. Chemical Composition and Potential Commercial Uses of Kolanut. Cola nitida, Vent (Schott and Endicher). Ghana J Agric Sci. 1975; 8: 121-125.

[5] Akinbode A. Kola nut production and trade in Nigeria. Nigeria Institute for Social and Economic Research. Ibadan. 1982.

[6] Okoli B. J., Abdullahi K., Myina O. and Iwu G. Caffeine Content of Three Nigerian Cola. J Emerg Trends in Engr Appli Sci. 2012; 3: 830-833.

[7] Lowe H. I. C., Watson C. T., Badal S., Peart P., Toyang N. J. and Bryant J. Promising Efficacy of the Cola acuminata Plant: A Mini Review. Adv Biol Chem. 2014; 4: 240-245.

[8] Jarvis G. The Rise and Fall of Cocaine Cola. 2002.

[9] Adesuyi A. O., Elumm I. K., Adaramola F. B. and Nwokocha A. G. M. Nutritional and phytochemical screening of Garcinia kola. Adv J Fd Sci Technol. 2012; 4 (1): 9-14.

[10] Ibiblio J. O. Some Medicinal Plants of Nigeria. Ibadan publishers Nig. Ltd. 1983.

[11] Leakey R. Potential for novel food production from agroforestry trees: A Review. 2001.

[12] Omode A. A., Fatoki O. S. and Olaogun K. A. Physicochemical properties of some underexploited and non-conventional oilseeds. J Agric Fd Chem. 1995; 43: 2850–2853.

[13] Onochie C. F. A. and Stanfield D. F. Nigerian Trees. Gov. Printer, Lagos, Nigeria. 1960.

[14] Okoli C., Okoli I. C., Emenalom O. O. and Esonu B. O. The emerging nutritional benefits of the African wonder nut (Garcinia kola Heckel): A Review. Global J Animal Sci Res. 2014; 2 (2): 170–183.

[15] Irvine FR. Woody Plants of Ghana. Oxford University press, Oxford. 1961.

[16] Adegbehingbe O. O., Adesanya S. A., Idowu T. O., Okimi O. C., Oyelami O. A. and Iwalewa E. O. Clinical effects of Garcinia kola in knee osteoarthritis. J Orthop Surg Res. 2008; 3: 34

[17] AOAC. Official Methods of Analysis. 17th Edition. Washington DC: Association of Official Analytical Chemists. 2002.

[18] Durand D., Hubert A., Nafan D., Haziz S., Pacome A. N., Farid B., Adolphe A., Joachim D. G., and Lamine B. Antimicrobial, Antioxidant, Cytotoxic Activities and Phytochemical Assessment of Cola acuminata Used in Benin. Int J Pharm Pharm Sci. 2015; 7: 102 – 109.

[19] Dewole E. A., Dewumi D. F. A., Alabi J. Y. T and Adegoke A. Proximate and phytochemicals of Cola nitida and Cola acuminata. Pak J Biol Sci. 2013; 16: 1593-1596.

[20] Ajai A. I., Ochigbo S. S., Jacob J. O., Ndamitso M. M. and Abubakar U. Proximate and Mineral Compositions of Different Species of Kola Nuts. Europ J Appl Engr Sci Res. 2012; 1: 44-47.

[21] Adeleke R. O., Abiodun O. A. Chemical composition of three traditional vegetables in Nigeria. Pak J Nutr. 2010; 9 (9): 858–860.

[22] Atanda O. O., Olutayo A., Mokwunye F. C., Oyebanji A. O. and Adegunwa M. O. The Quality of Nigerian Kola Nuts. African Journal of Food Science. 2011; 5: 904-909.

[23] Eleyinmi A. F., Bressler D. C., Amoo I. A., Sporns P. and Oshodi A. A. Chemical Composition of Bitter Cola (Garcinia kola) Seed and Hulls. Pol J Food Nutri Sci. 2006; 56: 395-400.

[24] Brosnan J. Inter-organ amino acid transport and its regulation. J Nutri. 2006; 133: 2068S–2072S.

[25] Pereira M. A., O'Reilly E., Augustsson K., Fraser G. E., Goldbourt U. Heitmann B. L., etc. Dietary fibre and risk of coronary heart disease: A pooled analysis of cohort studies. Arch Int Med. 2004; 164 (4): 370-376.

[26] Melgarejo P., Salazar D. M., Amoros M. and Arete F. Total lipids content and fatty acids composition of seed oils from six Pomangante cultivars. J Sci Food Agric. 1995; 69 (2): 253-256.

[27] James H. O., Keefe J., Hussam A., Sastre A., David M. S, and William S. H. Effect of omega-3 fatty acids on resting heart rate, heart rate recovery after exercise, and heart rate variability in men with healed myocardial infections and depressed ejection fractions. Am J Cardiol. 2006; 97: 1127-1130.

[28] Aremu M. O., Mamman S., Olonisakin A. Evaluation of fatty acids and physiochemical characteristics of six varieties of bambara groundnut (Vigna subterranean L Verdc) seed oils. Larivista Italiana Delle Sostanze grasse. 2013; XC: 107-113.

[29] Olonisakin A. Evaluation of fatty acid composition of some underutilized plant oils seeds found in Akoko area of Ondo State, Nigeria. Futa J Res Sci. 2014; 10 (2): 246-251.

[30] Branch W. D., Nakayama T. and Chennan M. S. Fatty acid variation among US runner type peanut cultivars. J Am Oil Chem Soc. 1990; 67: 591-593.

[31] Alozie Y., Akpanabiatu M. I., Umoh I. B., Eyong E. U. and Alozie G. A. O. Amino acid composition of Dioscorea dumetorum varieties. Pak J Nutr. 2009; 8 (2): 103-105.