World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Published by Atom and Cell Publishers
Available online at: http://www.wjpsonline.com/
Research Article

Nutritive and Anti-nutritive composition of Wild grown *Canavalia gladiata* seeds

[1, 2]Otori A and [1]Mann A

[1]Department of Chemistry Federal University of Technology Minna, PMB 65, Niger State, Nigeria
[2]Department of Chemical Engineering, Federal Polytechnic Bida, Niger State, Nigeria

Received: 04-02-2014 / Revised: 13-02-2014 / Accepted: 21-02-2014

ABSTRACT

The wild *Canavalia gladiata* seeds were widely distributed in Nupeland, North Central Nigeria. It was obtained and processed by decoating, sun drying and grinding into powder. Using petroleum ether (40-60^{o}C), the fats was extracted, the protein content, ash content, crude fibre, moisture, carbohydrate with respective values of 3.60±0.14, 11.1±0.83, 4.25±0.11, 3.39±0.27, 5.85±0.47 and 72.3±0.08 % as well as the mineral contents were determined using standard methods. The mineral composition determined from the *C. gladiata* seeds shows higher values of potassium, zinc, iron and calcium 25.15±0.03, 25.89±0.27, 18.3±0.14 and 17.25±0.49 mg/100 g respectively. This seed analyzed contains low yield of anti-nutritional contents which suggested that, it could be safe for human consumption since it fell below the lethal dose limit. The sample contains reasonable amount of essential and non-essential amino acids with yield varying between 48 and 52%. The presence of unsaturated and saturated fatty acids in the *C. gladiata* was 96 and 4% respectively. The higher percentage of unsaturated fatty acid present makes this seed desirable for consumption by the person with heart diseases. In addition, from the data obtained this oil becomes attractive options for commercial purposes since it is suitable for the manufacture of soaps, lubricating oil, candles as well as pharmaceutical industries.

Keywords: *Canavalia gladiata*, nutritional, anti-nutritional, saturated fatty acids, unsaturated fatty acids

INTRODUCTION

Worldwide, natural sources are increasingly becoming important in nutrition and commerce because they are sources of protein, dietary energy, anti-oxidant, bio-fuels and raw material for the manufacture of industrial products. Protein energy malnutrition is among the serious problems tropical developing countries are facing today. The average Nigerian does not consume enough protein of animal origin and animal protein is more efficient than plant protein in providing the amino acid necessary for tissue development repair and function [1]. This can be attributed mainly to the ever-increasing population as well as the enhanced dependence on a cereal based diet, scarcity of fertile land and degradation of natural resources. It has been estimated that 800million malnourished people exist in some of the least developed countries [2]. This wild seed are rich in vitamin, minerals and protein. These constituents are essential for normal pathogen [3]. Although the world seed are delicious and nutritious more consumption of such seeds are hazardous to our body, so before eating it must be checked whether proper amount of anti-nutritional factors. The anti-nutritional factors such as tannin, saponin, oxalic acid and phytic acid have adverse effect on health through inhibition of protein digestion, growth, iron and zinc absorption [4]. Levels of anti-nutritional factors in some wild edible fruits of Nigeria were investigated [5, 6]. The aim of this research is to determine the nutritive and anti-nutritive composition of this seed.

MATERIALS AND METHODS

Collection of Samples: The wild seed (*Canavalia gladiata*) sample used in this research work were collected between March and July, 2012 from different villages in Nupeland, North Central Nigeria. The seed samples were washed and rinsed with clean water and sun dried for five days. The dried seed samples were ground into fine powder with electric grinder (Fritsch, Idar obserstein,

***Corresponding Author Address:** Otori A, Department of Chemistry Federal University of Technology Minna, PMB 65, Niger State, Nigeria; E-mail: abdumann@gmail.com*

Germany) with mesh size (0.5 mm) and stored in a well labeled air tight polythene bag for analysis.

Methods

Moisture content: 2 g of each sample were put into the crucible, dried in an oven (Leniscope, England) at 105^{o}C overnight. The dried samples were cooled in a dessicator for 30 minutes and weighed to a constant weight. The percentage loss in weight was expressed as percentage moisture content [7].

Ash content : 2.00 g of each of the grounded samples were placed in each crucible and ashed in a muffle furnace (Lenton Furnaces, England) at 600^{0}C for 3 h. The hot crucibles were cooled in a dessicator and weighted. The percentage residual weighed was expressed as ash content [7].

Crude lipid content: 2.00 g of each sample were used for determining crude lipid by extracting lipid from it for 5 h with petroleum ether in a soxhlet extractor.

Protein determination: Total protein was determined by the Kjeldahl method as modified by Williams [8]. About 0.5g of the samples were weighed into a filter paper and put into a Kjedahl flask, 8-10 cm^3 of concentrated H_2SO_4 were added and then digested in a fume cupboard until the solution becomes colourless. Distillation was carried out with about 10 cm^3 of 40% of NaOH. The distillate was received with 5 cm^3 of 4% boric acid in a mixed indicator till the boric acid solution turned green. Titration was done in the receiver flask with 0.01 M HCl until the solution turned red.

Crude fibre content: 2.00g of each sample were used for estimating crude fibre by acid and alkaline digestion methods with 20% H_2SO_4 and NaOH solution.

Carbohydrate determination: The carbohydrate content was calculated using following: available carbohydrate (%), = 100 – {protein (%) + Moisture (%) + Ash (%) + Fibre (%) + Fat (%)}.

Metabolisable energy: The metabolisable energy was calculated in Kilojoules per 100g (kJ/100g) by multiplying the crude fat, protein and carbohydrate values by Atwater factors of 37, 17 and 17 respectively.

Minerals analysis: Sodium and potassium were determined using Gallenkamp Flame analyzer, while calcium, magnesium, iron, manganese, zinc, chromium, lead and copper were determined using Buch Model 205 Atomic Absorption Spectrophotometer. Phosphorus level was determined using the phosphovanado molybdate colorimetric techniques on JENWAY 6100 Spectrophotometer [7].

Anti-nutritional properties: Oxalate and cyanide contents were determined using the method of Trease and Evans [9]. Phytate content was determined by the method described [10], flavonoids and alkaloids were determined using the method of Harborne [11]. Saponins content was determined by the method described by Oloyede [12], tannins content was also determined by Onwuka [13] and hydrocyanic acid was determined by the method [7].

Fatty acids compositions: The fatty acid analysis was carried out using GCMS. The fatty acids were observed as peaks whose retention times were measured by the spectrometer detector and compared with those of known standards of the Wiley library.

Physicochemical parameters: Physicochemical parameters were determined using the standard method of Official Analytical Chemists [7].

Amino acid contents: 50 g of ground seed sample was defatted with chloroform and methanol mixture in a ratio 1:1, then, 30 g of the defatted sample was put into a glass ampoule, 7 ml of 6 M HCl was added and oxygen expelled by passing nitrogen into the ampoule was put in the oven at 105^{o}C for 22 h, allowed cool and filtered. The filtrate was then evaporated to dryness at 40^{o}C under vacuum in a rotary evaporator. The residue was dissolved with 5ml acetate buffer (pH 2.0) and loaded into the amino acid composition and the seed samples were determined by ion exchange chromatography (IEC) method using the Technicon Sequential Multi-sample Amino acid Analyzer (Technicon Instruments Corporation, New York).

RESULTS AND DISCUSSION

The result of the proximate composition of the *C. gladiata* seeds analyzed as shown in table 1 revealed that the moisture content of the entire samples from 5.85±0.47%. These values are high when compared to 4.26%, 5.62% and 6.05% observed in *Detarium microcapum*, *Parkia biglobosa* and *Moringa oleifera* [13]. Based on the safe storage limit of moisture (15%) for seed materials, the low level of moisture content in all the tested samples suggest that it can be stored for a long time without spoilage since higher water activity can enhance microbial action thereby causing food spoilage [13]. The values of ash content from the result ranges from 4.25±0.11%

and this value was observed to be low when compared to some seeds consumed in Nigeria such as *Talinum triangulare* (19.5%), *Corchorus olitornus 1*8.2% [14]. Ash content is useful in assessing the quality grading of seeds and also gives an idea of the amount of mineral element present in the seed [15]. Crude protein content of these samples was found to be 11.10±0.83%. Similar protein content of 11.20% to 18.80% was obtained in *Blighia sapida* seeds [13]. The values are higher compared to those observed in *B. diffusa* (2.17%) and *Commelina nudifera* (1.42%) [16]. The results, therefore, suggest that the protein content of these seeds can make significant contribution to dietary intake especially during pre-harvest period, when domesticated food is in short supply. Values of fat content recorded in this work were 3.60±0.14%. This value was high when compared with the values of 0.43% in the seed of *Parkia filicoidea* reported by Oderinde *et al.* [17]. This shows that these seeds can serve as a fat supplement in food diet. The value of the crude fibre recorded in from this work was 3.39±0.27% their values fall within the values reported for most legumes [18]. The value was observed to be moderate when compared to some other seeds such as *Alternanthera sessilis* (5.32%) [18]. High fibre in food materials decrease dry matter digestibility in animals [13]. The available carbohydrate content of this sample was 72.3±0.08%. This was higher compared to the values of *Parkia biglobosa*, 53.52% in *Blighia sapida* 62.75% in *Moringa oleifera* and 63.1% in *Talinum triangular* [19]. According to FAO/WHO [20] limit (55% to 75%) of carbohydrate intake, the result therefore revealed that *C. gladiata* among the other samples is rich in carbohydrate which is very important for the correct functioning of vital physiological system of the body [21].

The result of the mineral composition of the sample is shown in Table 2. It indicates that calcium content in this seed sample was 17.25±0.49mg/100g, this value is low when comparable to those of *Parkia biglobosa* and *Blighia sapida* (26 mg/100 g) (30 mg/100 g) reported by Oderinde *et al.* [17]. The recommended daily allowance for calcium is 210-1200 mg/day [19] and this seed sample analyzed is poor sources of calcium. Potassium content from the result was 25.15 ±0.83mg/100g. These values are high compared to those of *B. diffusa* 0.71mg/100g and *C. nudifora* of dry weight 0.68mg/100g [13]. Magnesium is an important mineral in connection with circulatory disease such as heart diseases and calcium metabolism in bone [16]. The magnesium content of this seed was observed to be 15.17±0.01 mg/100g. The values are high when compared to 7.76 mg/100 g in *Parkia biglobosa* and 6.65 mg/100 g in *B. diffusa* [12](Adeboye, 2007). The zinc content from the result 25.89±0.27 mg/100 g. Zinc value was high compared to those reported in *Blighia sapida* 3.30mg/100g and *C. nudiflora* 4.2 mg/100 g [17] (Richard *et al.,* 2007). Zinc is known to play a role in gene expression, regulation of cellular growth and participants as co-factor enzymes responsible for carbohydrate protein and nucleic acid, metabolism [14]. For iron content, the value was high when compared to 0.13 mg/100 g in *B. diffusa*, 0.016 mg/100 g in *C. nudiflora* reported by Onwuka, [13]. When compared with Recommended Daily Allowance (RDA) for iron (10 mg to 15 mg), it can be conclude that this sample are good source of iron. Copper is known for the role it plays in heamoglobin formation and also contribution to iron energy metabolism [22]. The concentration of copper in this sample was found to be 3.95 ±0.32mg/100g. This value was higher when comparable to 2.41 mg/100g in *C. olitorius* and 0.2mg/100g in *L. africana* seed [14]. From the result, this sample is source of copper based on RDA of 1.5 to 3 mg [23]. Manganese content of the sample was 1.15 ±0.07 mg/100 g. These values are high compared to 0.46 mg/100g observed in *B. diffusa* and 0.16 mg/100g in *C. nudiflora* [18], while Chromium content was not detected. The value of phosphorus obtained from the analyzed sample was 14.15 ±0.21 mg/100g. The value is very low when compared to 4000mg/100g obtained for Benni seeds [24]. The sodium content obtained from the analyzed sample was 11.7±0.14 mg/100g. This value was high when compared to 1.96 mg/100g obtained in cocoa bean, 1.2 mg/100g in *C. nudiflora*, and 1.7 mg/100g in almond seed.

Anti-nutritional factors affect the availability of nutrients required by the body and interfere with metabolic process so that growth and development of the body is negatively influence [19]. The result in Table 3 shows the anti-nutritional factors *C. gladiata*. The result reveals saponin content of 20.5 mg/100g. Saponins are known for reducing the uptake of certain mineral element including glucose [13]. The value of the tannin for the sample analyzed was 20.5 mg/100g. Tannin has the ability of precipitating certain protein and thereby making them indigestible [13]. The flavonoid content was determined to be 20.3 mg/100g, flavonoids which are phenolic compounds that serve as flavoring ingredient of spices and vegetable [25]. The alkaloid content was 22.4 mg/100g. Alkaloids are often toxic to men and may have dramatic physiological activities hence they are widely used in medicine [25]. The oxalate content 21.0 mg/100g. The oxalate content reported in this study is lower than 695 mg/100g reported in dehulled seeds of African locust bean 1,020 mg/100g in

Hyphacene thebaica seed and 851 mg/100g in seed kernel of *Balanites aegyptiaca* [10]. The hydrocyanic acid (HCN) content in the sample was 19.5 mg/100g. This value was low when compared to the toxic level of 35 mg/100g, and 20 mg/HCN. However, it is high when compared with the acceptable standard. The phytate content in the sample analyzed was 25.2 mg/100g. Phytate help inadequate iron bioavailability [26].

Table 4 shows the data of amino acid composition of the analyzed seed samples. The seeds are rich in both essential and non-essential amino acids. The levels of some of the essential amino acid are comparable to that of FAO/WHO [20]. The results therefore show that these seed proteins would compliment well with those protein sources that are low in hysine, value, methionine, threonine, lencine and isoleucine. This result was similar to those reported by Onwuka [13] and those of *V. colorata* and *V. calvoana* [19]. The total essential and non-essential amino acids were 48% and 52% respectively was recorded in this work. The physical properties of seed oils from this seed were shown in table 5. The *n*-hexane extractable oil this seed was lower than the conventional seed oils of 28.0% of palm kernel seed. The percentage oil yields were 10.52±0.80 in this sample. The oil yield was low compared to 7.90±0.12% reported by Ajayi and Oderinde [27]. At room temperature (29^{o}C) all the oil are liquids. The colour of the oil was dark brown. The specific gravity of the oils at 25^{o}C was 0.84 ± 0.16. The seed oil had offensive odour. The refractive index of the seed oils at 20^{o}C was 1.23±0.01. Refractive index is the ratio of the velocity of light in vacuum to the velocity of light in a medium is an indication of the level of saturation of the oil [28]. The Iodine value was 7.30±0.01. This value classify the oils as non drying similar non-drying oil values have been reported for *D. edulis* pulp seed and *Cucurbita maxima* seed [27]. This non-drying attribute qualified them for use in the paint industry [29]. The iodine value obtained from this analysis indicates that the oils contain appreciable level of unsaturated bonds. Storage procedure used should ensure protection of oil from oxidative deterioration. A good drying oil should have iodine value of 100gI_2/100g [30]. Acid value is used as an indicator for edibility of oil and suitability for used in the paint industry. The acid value of the seed oils was 2.12±0.15. Pearson [31] reported acid values of 4 for sesame, 7 for olive oil and 5 for rape seed. Free fatty acid value of less than 3 was obtained. The oils could therefore be used as an indicator of deterioration. The peroxide value 2.24±0.11 was recorded in this work. Fresh oils have values less than 10mEq/Kg. values between 20 and 40 results to rancid taste. Saponification value is used in checking adulteration. The value of saponification in this work was 93.40 ± 2.12 mg KOH/g of oil.

The result of fatty acid compositions were presented in table 6 which contains reasonable amount of unsaturated and saturated fatty acids. The presence of unsaturated and saturated fatty acids in the *C. gladiata* was 96 and 4% respectively. The higher percentage of unsaturated fatty acid present in this work, make this seed desirable for the person with heart diseases. The presences of both are to complement each other in other to ascertain the nutritional compositions of the seed in the body.

CONCLUSION

The result obtained from this work reveals that the *Canavalia gladiata* is a good source of protein and minerals. It contains low amount of anti-nutrition factors with reasonable level of fatty acids. It may be recommended for consumption by man and his animals.

Table 1: Proximate composition of the wild *C. gladiata* seeds

Composition	*%*
Moisture	5.85 ± 0.47
Fat	3.60 ± 0.14
Crude protein	11.1 ± 0.83
Crude fibre	3.39 ± 0.27
Ash	4.25 ± 0.11
Carbohydrate	72.3 ± 0.08
Energy value	366.1 ± 1.75

Table 2: Mineral composition of the wild *C. gladiata* seeds analysed

Composition	(mg/100 g)
Sodium	11.7 ± 0.14
Potassium	25.15 ± 0.03
Calcium	17.25 ± 0.49
Iron	18.3 ± 0.14
Copper	3.6 ± 0.14
Manganese	1.15 ± 0.07
Zinc	25.89 ± 0.27
Chromium	ND
Magnesium	15.17 ± 0.01
Phosphorus	14.15 ± 0.21

ND: not detected

Table 3: Anti – Nutritional Factors of the wild *C. gladiata* Seeds

Parameter	(mg/100 g)
Phytate	25.2
Oxalate	21.0
Tannin	20.5
Cyanide	19.5
Flavonoid	20.3
Alkaloid	22.4
Saponin	20.5

Table 4: Amino acid composition of the wild *C. gladiata* seeds

Amino acid	**(g/100 g protein)**
Lysine	5.21
Histidine	2.38
Arginine	6.30
Aspartic acid	9.85
Threonine	3.30
Serine	3.62
Glutamic acid	12.36
Proline	3.29
Glycine	3.82
Alanine	4.09
Cystine	0.86
Valine	3.54
Methionine	1.04
Isoleucine	3.51
Leucine	7.80
Tyrosine	3.06
Phenylalanine	4.40

Table 5: Physico–Chemical properties of the extracted wild *C. gladiata* seed oils

Properties	***C. gladiata***
%Yield	10.52 ± 0.80
Specific gravity at (25^{o}C)	0.84 ± 0.16
Refractive index at (20^{o}C)	1.23 ± 0.10
Colour	Dark brown
Odour	Agreeable
State	Liquid
Acid Value (mg NaOH/g of oil)	2.12 ± 0.15
Saponification value (mg KOH/g of oil)	93.40 ± 2.12
Iodine value (gI_2/100g of oil)	7.30 ± 0.01
Peroxide value	2.24 ± 0.17

Table 6. Analytical parameters deduced from GC-MS spectrum for *C. gladiata* seed

Line no	Compound	Molecular formula	Molar mass	R.T	Area%	Fragmentation Peaks
1	Methyl tetradecanoate	$C_{15}H_{30}O_2$	242	13.641	2.13	211, 185, 143, 129, 87, (74) 57
5	9-Octadecenoic acid	$C_{19}H_{36}O_2$	296	17.432	50.08	222, 180, 166, 152, 69, (55), 41
6	6-Octadecenoic acid	$C_{18}H_{34}O_2$	282	18.072	1.69	222, 97, 83, 69, (55),41, 27

( ) Represents the base peak

REFERENCES

1. FAO|WHO|UNU. Protein and amino acid requirement in human nutrition, WHO press, 2003; p.162.
2. FAO|WHO/UNU. Protein and amino acid requirement in human nutrition, WHO press, 2004; pp. 100-106.
3. Bal AY. Metabolic effects of dietary fibre consumption and prevention of diabetes. J Nutr 2007; 135:250-258.
4. Largson AB *et al*. Dispensable and indispensable amino acid for human. J Nutr 2006; 120:1520.
5. Umaru HA *et al*. Levels of anti-nutritional factors in some wild edible fruits of Northern Nigeria. African J. Biotech. 2007; 6:1935-1938.
6. Ojiyako OA, Igwe CU. The nutritive, antinutritive and hepatotoxic properties of *Trichosanthes anguina* (snake tomato) fruits from Nigeria. Pak. J. Nutr 2008; 7:85-89.
7. AOAC. Official methods of analysis Association of Analytical Chemist 15th Edition, Washington DC. pp.12-135, 1990.
8. Williams CL *et al*. A new recommendation for dietary fibre in childhood Pediatrics. 1964; 96:985-988.
9. Trease GE, Evans WC. Pharmacognosy, 13th Ed. London, Bailliere Tindall, 1989
10. Ola FL and Oboh G. Anti-nutritional Factors, in Nutritional Quality of Plant Foods. The J Technosci 2000; 4:1-3.
11. Harborne JB. Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. Chapman and Hall, London, 1973.
12. Oloyede OI. Chemical profile of unripe pulp of *Carica papaya.* Pak. J Nutr 2005; 4:379-381.
13. Onwuka, GI. Food Analysis and Instrumentation Theory and Practice. Naphthali Print, Nigeria. pp. 63-98, 2005.
14. Adeboye GB *et al*. Physicochemical properties of biodiesel produced from *Jatropha curcas* oil and fossil diesel. J Microbiol Biotechnol Resour 2007; 1:12-16.
15. Smart J. *Canavalia gladiata* (Jacq.) D.C. (Sword bean). Tropical Pulses. Longman Group Ltd, London, 1996.
16. Zock PL and Katan MB. Hydrogenation alternatives: effects of trans-fatty acids and stearic acid versus linoleic acid on serum lipids and lipoprotein in humans. J Lipids Res 2005; 33:399-410.
17. Oderinde RA *et al*. Dietary effects on growth, plasma lipid and tissues of rats fed with non-conventional oil of *Telfairia occidentalis*. J Sci Food Agric 2004; 84:1715-1720.
18. Anhwange BA *et al*. Nutritive Value and Anti-Nutritional Factors in Wild Seeds. J Fisheries International 2006; 2:73-76.
19. Richard AE *et al*. Nutritional Component of Some non Conventional Leaf Vegetable Consumed in Cameroon. Pak J Nutr 2007; 6:712-717.
20. FAO/WHO/UNUProtein and amino acid requirements in human nutrition, WHO Press 150, 2007.
21. Smith GF *et al*. Mesembs of the World Pretoria. Briza Publications, 1998; pp. 252-255.
22. Akintayo ET *et al*. Chemical composition, physicochemical and functional properties of Akee (B. Sapida) pulp and seed flours. Food Chem 2002; 77:333-336.
23. National Research Council. Recommended Dietary Allowance. USA, Nutritional Review. 1980; 374-395.
24. Dashak DA, Fali CN. Chemical composition of four varieties of Nigerian Benniseeds (*Sesamum indicum*). Food Chem 1993; 47:253-255.
25. Olaofe O, Sanni CO. Nutritional Component of some non conventional leaf Vegetable consumed in Cameroon. Food Chem 1988; 30:73-77.
26. Mitchikpe ECS. Determination of chemical composition of *Prosopis africana*, J Food Composition Analysis. 2008; 21:17-23.
27. Ajayi IA, Oderinde RA. Studies on the oils characteristics of *Dacryodes edulis* pulp and seeds. Discov Innov 2002; 14:20-24.
28. Oderinde RA *et al*. Characterization of seed and seeds oil of Hura Crepitans and the kinetics of degradation of the oil during heating. Electron J Environ Agric Food Chem 2009; 8:201- 208
29. Dosunmu MI, Ochu C. Physicochemical properties and fatty acid composition of lipids extracted from some Nigerian fruits and seeds. Global J Pure and Applied Sci 1995; 1:45 - 50.
30. Abayeh OJ *et al*. Oil content and oil quality characteristics of some Nigerian oil seeds. J Pure Appl Sci 1998; 1:17-23.
31. Pearson D. The chemical analysis of foods. 7th ed. London: Churchill Livingstone, 1976.