Evaluation of the Proximate Contents of Bambara Groundnut Vigna subterranean (L.) Verdc Grown in MadobiLGA, Kano State, Nigeria

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Authors’ contributions
This work was carried out in collaboration between all authors. Author AJA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Authors AMD and TMA managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Evaluating the proximate composition of locally utilized crop with nutritional and industrial potentials is a timely gesture.
Aim: The study was to determine the proximate contents of Bambara Groundnut (Vigna subterranean (L.) Verdc) grown in MadobiLGA, Kano state, Nigeria.
Design and Methodology: Samples were collected from different localities of the LGA to constitute composite sample out of which representative sample was drawn for proximate composition evaluation according to standard methods of AOAC.
Results: The Bambara groundnut grown in the study area shows the mean percentage (%) protein (18.83±0.49), lipids (7.05±1.82), fiber (5.74±1.09), carbohydrate (63.37±2.57), moisture (12.59±1.14) and ash (3.52±0.22). The result indicates that Bambara groundnut grown in Madobi could be an excellent source of protein, lipid, carbohydrate and mineral elements.

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Conclusion: It can be concluded that Bambara groundnut grown in Madobi LGA, Kano State, Nigeria has nutritional potentials that can alleviate nutritional problems in the area and beyond when properly explored.

Keywords: Bambara groundnut; Madobi LGA; proximate composition.

1. INTRODUCTION

Bambara groundnut (*Vigna subterranean* (L.) Verdc. Or *Voandzeia subterranea* (L.) Thouars) is one of the most valuable food crops in Africa and other parts of the world and has been identified as the third most important grain legume in semi-arid Africa [1]. It is resistant to high temperature and is suitable for marginal soils where other leguminous crops cannot be grown [2]. In addition, it makes very little demand on the soil and has a high nutritive value. For these reasons, it is not prone to the risk of total harvest failure even in low and uncertain rainfall. Due to its high protein value, it is a very important crop for poor people in Africa who cannot afford the expensive animal protein [3]. It is a nutritionally balanced seed containing essential amino acids such as isoleucine, leucine, lysine, methionine, phenylalanine, threonine and valine [4,5]. Large seeds are preferred over smaller ones, e.g. for use as snack and smaller seeds are ground into flour for use in various recipes.

Bambara groundnut is a leguminous plant, often considered an inferior food eaten by peasants, described as being ‘poor man’s meat’. They never assumed the importance of a staple food as did the cereal crops like wheat, rice, maize, or barley. Yet, they play an important synergistic role with staple foods both in meeting nutritional requirements and fertilizing the soil [6]. Of all foods, legumes most adequately meet the recommended dietary guidelines for healthful eating. They are high in carbohydrate and dietary fiber, mostly low in fat, supply adequate protein while being a good source of vitamins and minerals [7]. The importance of grain legumes in the world is high due to their significance in human and animal nutrition. Legume seeds can also become an industrial raw material with a wide range of non-food applications [8]. This work is aimed at determining the proximate content of Bambara groundnut grown in Madobi LGA, Kano state, Nigeria.

2. MATERIALS AND METHODS

2.1 Materials

Reagents used includes Concentrated Sulphuric acid, Concentrated Hydrochloric acid, Concentrated Nitric acid, Boric acid, Sodium hydroxide pellets, Methyl red, Sodium chloride, Potassium chloride and Chloroform and Methanol, are of analytical grade obtained from SIGMA chemical company.

Equipment used includes; Weighing balance (Mettler Toledo), Top loading balance (pm–16–K), Hot air oven (Kotterman D3165), Spectrophotometer (Spectrum Lab 752s).

2.2 Sample Collection and Preparation

The sample of Bambara Groundnut (*Vigna subterranean* (L.) Verdc) used in this research was collected from different farmers in Madobi LGA Kano state, Nigeria, to constitute a composite sample. Representative sample (1 kg) was dried and the seeds were removed from the hulls and brought to the Biochemistry laboratory, Bayero University Kano. The sample was ground to powder and stored in plastic container.

2.3 Determination of Proximate Composition

The proximate composition of Bambara groundnuts were analyzed using the methods described in AOAC [9].

2.4 Principles of the Proximate Content Determination

For moisture it involves the measurement of weight loss due to evaporation of moisture in hot air oven and the weight loss after drying to a constant weight. Ash content was determined by igniting a known amount (5.0 g) of dried material (moisture free) in a muffle furnace. This is based on the fact that all organic matter can be eventually burnt to produce water and carbon (IV) oxide. For crude Fat, the dried sample was
placed in continuous extractor (soxhlet) and subjected to extraction with acetone. The organic soluble substances thus removed are collected in a flask, dried and weighed. For carbohydrates determination, the digestible carbohydrate content of the sample is acids hydrolyzed into its constituent monosaccharides. The extracted monosaccharides then form complex with anthrone that absorbs at 620 nm [10]. Crude Protein was determined from the total nitrogen content of the sample, which is mainly from the protein and other non-protein nitrogenous compounds such as amides and ammonium compounds, the crude protein content is obtained by multiplying the nitrogen content of foods by 6.25.

The equation for the digestion, distillation and the titration processes are:

1. Conc. $\text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$

   Organic matter $\rightarrow \text{CO}_2$

2. $(\text{NH}_4)_2\text{SO}_4+2\text{NaOH} \rightarrow 2\text{NH}_3+2\text{H}_2\text{O}+\text{Na}_2\text{SO}_4$

   $\text{NH}_3+\text{H}_2\text{O} \rightarrow \text{NH}_3\text{OH}$

   $\text{NH}_3\text{OH}+\text{H}_3\text{BO}_3 \rightarrow (\text{NH}_3)_2\text{BO}_3+\text{H}_2\text{O}$

   $(\text{NH}_3)_2\text{BO}_3+\text{H}_2\text{SO}_4 \rightarrow (\text{NH}_3)_2\text{SO}_4+\text{H}_3\text{BO}_3$

### 3. RESULTS AND DISCUSSION

The proximate contents are presented in Table 1. The parameters determined includes; moisture, ash, protein, lipid, fiber and carbohydrate. The result showed that Bambara groundnut is an excellent source of protein, fiber and carbohydrate. The amount of fiber determined is of interest (Table 1).

| Parameters   | % proximate contents |
|--------------|----------------------|
| Moisture     | 12.59±1.14           |
| Ash          | 3.52±0.22            |
| Protein      | 18.83±0.49           |
| Lipid        | 7.05±1.82            |
| Fiber        | 5.74±1.09            |
| Carbohydrate | 63.37±2.57           |

*The estimated values are MEAN±SD, n = 5.*

### 4. DISCUSSION

The moisture content of the Bambara groundnut grown in MadobiLGA town, Kano state, Nigeria is 12.59±1.14, and that of Yetunde et al. [12], who found moisture content of 11.09% in Bambara groundnut. The ash content of 3.52±0.22 also agreed with report of Ahmed et al. [13] (3.63%). The results also showed that Bambara groundnut produced in the study area contain appreciable amount of protein. The protein composition obtained is similar to those of Ferial and Azza [14] and Duplex et al. [11] with 17.70±0.44 and 18.83±0.30% values respectively. In terms of lipid composition the result obtained (7.05±1.82%) support those of Duplex et al. [11] (7.71%); Nwodo and Obinna [15] (7.35±0.02). It however contradicts report by Dillon [16] that the fat content of most grain legumes do not exceed 3g/100g. Bambara groundnut may be the best among legumes in terms of fats content and may provide right amount of fat in the diet. The fiber content of (5.74±1.09) is similar to those obtained by Yetunde et al. [12] (5.12%) while carbohydrate composition obtained (63.37±2.57) is similar to that of Duplex et al. [11] (67.55±1.44). The results indicates that Bambara groundnut is an excellent source of protein, lipid, carbohydrate and dietary fiber, which people that cannot afford animal protein can resort to. Nwodo and Obinna [15] reported that Bambara groundnut is an important food source that can be exploited particularly in the developing countries where there is shortage of animal protein and under nutrition. The combination of plant proteins can provide adequate and balanced mixture of essential amino acids [15,5].

The amount of fiber and carbohydrates observed in this study was also appreciable. Though dietary fibers cannot be digested by human beings, they have useful roles in providing roughage that aids digestions [17]. Dietary fibers reduce the risk of cardiovascular diseases caused by high cholesterol level, by decreasing cholesterol levels in the body [18]. Some types of soluble fibers bind to bile acids in the small intestine, making them less likely to enter blood circulation. This in turn reduces cholesterol levels in the blood and normalizes blood lipid levels, once fermented in the colon, produce short-chain fatty acids as by-products with wide-ranging physiological activities [18]. Viscous soluble fibers may also attenuate absorption of sugar, thereby reduces sugar response after meal, while insoluble fiber is associated with reduced risk of diabetes, but the mechanism by which this occurs is unknown [19]. One type of insoluble dietary fiber, resistant starch has been shown to directly increase insulin sensitivity in...
healthy people [20,21], in type 2 diabetes [22], and in individuals with insulin resistance, possibly contributing to reduced risk of type 2 diabetes and also reduces the risk of development of obesity [23-25]. The role of dietary fiber in reducing the risk of obesity is related to its unique physical and chemical properties that aid in early signals of satiation and enhanced or prolonged signals of satiety.

5. CONCLUSION

Base on this study, Bambara groundnut may be used by people with diabetes and obesity, by virtue of its protein, and fiber contents. The relatively high carbohydrate content may not have significant effect due to the fiber content, which can weaken the absorption of sugar, reduces its (sugar) response and increase insulin sensitivity. More research should therefore be carried out in order to determine the glycemic index of whole Bambara groundnut and as recipe. The finding may therefore change the neglecting attitude toward Bambara groundnut to improve production, utilization and industrialization.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chomchalow N. Bambara groundnut. In Proceedings of the FAO/UNDP project RAS/89/040 workshop on underexploited and potential food legumes in Asia. Ed. by Gowda CLL, Laosuwan P, Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok, Thailand. 1993;30–34.
2. Collision CT, Sibuga LP, Rarimo AJP, Azam-Ali SN. Influence of sowing date on the growth and yield of Bambara groundnuts landraces in Tanzania. Expt. Agric. 2000;36:1-13.
3. Baryeh EA. Physical properties of Bambara groundnuts. J. Food Engr. 2001; 47:321–326.
4. Ihekoronye AI, Ngoddy PO. Integrated Food Science and Technology for the tropics, University of Ibadan Press. Nigeria. 1985;283.
5. Alhassan AJ, Sule MS, Abubakar H, Muhammad YY. and Abdulmumin TM. Amino acid profile of Bambara nut (Vigna subterranea (L.) Verdc) cultivars of Kano State –Nigeria. Proceedings of the 27th Annual Conference of Nigerian Institute of Food Science and Technology (NIFST) Abuja; 2013.
6. Young VR. Soy protein in relation to human protein and amino acid nutrition. J Am Diet Assoc. 1991;91:828–835.
7. Messina M. Proceedings of the third international symposium on the role of soy in preventing and treating chronic disease. J Nutr. 2000;130:653S–711S.
8. Kozlowska H, Zdunczyk Z, Honke J. Legume grains for food and non-food uses. Proc. Of the 3rd European Conference on Grain Legumes; 1998.
9. AOAC Official methods of Analysis of the Association of Analytical Chemist. Washington D.C; 2005.
10. Pomeranz Y, Meloan EE. Food Analysis. Theory and Practice. West Port: A. V. Publishing Co. Inc. 1978;521–522.
11. Duplex TT, Elie F, Germain K, Felicite, M. Chemical composition and chemical properties of flours of four cultivars of Bambara groundnut (Vigna Subterranea L. Verdc. J. Cameroon Acad. Sci. 2004;4: 345-350.
12. Yetunde EA, Mary I, Olajumoke L, Ukpong U, Ime FA. Utilization of Bambara groundnut flour blend in bread production. J. Food Technol. 2009;7(4):111-114.
13. Ahmed GM, Ahmed A, Ahmed, M. Nutritive Evaluation of Bambara Groundnut (Vigna subterranea) pods, seeds and hull as animal feeds. J. Appl. Sci. Res. 2010;6(5):383-386.
14. Ferial MA, Azza AA. Effect of supplementation of bambara groundnut (Vigna subterranea L.) flour on the quality of biscuits. Afr. J. Food Sci. 2011;5(7):376-383.
15. Nwodo SC, Obinna, CN. Proximate analysis of Sphenostylis stenocarpa and Voadzeia subterranea consumed in South –Eastern Nigeria. Journal of Agricultural Extension and Rural Development. 2012; 4(3):57–62.
16. Dillon JC. Place des légumineuses dans l’ alimentation humaine. In: légumineuses alimentaires en Afrique, Université de Niamey- Niger (Ed). 1985;97-105.
17. Eva R. Food, health and you. A book on nutrition with special reference to East Africa. Macmillan publishers. London. 1983;14-25.

18. Anderson JW, Baird P, Davis RH. Health benefits of dietary fiber. Nutr Rev. 2009; 67(4):188–205.

19. Weickert MO, Pfeiffer AF. Metabolic effects of dietary fiber consumption and prevention of diabetes. J. Nutr. 2008; 138(3):439.

20. Robertson MD. Currie JM, Morgan LM, Jewell DP, Frayn KN. Prior short-term consumption of resistant starch enhances postprandial insulin sensitivity in healthy subjects. Diabetologia. 2003;46(5):659–665.

21. Robertson MD. Bickerton AS, Dennis AL, Vidal H, Frayn KN. Insulin-sensitizing effects of dietary resistant starch and effects on skeletal muscle and adipose tissue metabolism. Amer. J. Clin. Nutr. 2005;82(3):559–567.

22. Zhang WQ, Wang HW, Zhang YM, Yang, YX. Effects of resistant starch on insulin resistance of type 2 diabetes mellitus patients. Chinese J. Prev. Med. 2007;2(2): 101–104.

23. Johnston KL, Thomas EL, Bell JD, Frost, GS, Robertson MD. Resistant starch improves insulin sensitivity in metabolic syndrome. Diabetic Medicine. 2010;27(4): 391–397.

24. Maki Kevin C, Pelkman CL, Finocchiaro, ET, Kelley KM, Lawless AL, Schild AL, Rains TM. Resistant starch from high-amyllose maize increases insulin sensitivity in overweight and obese men. J. Nutr. 2012;142(4):717–723.

25. Robertson MD. Bickerton AS, Dennis AL, Vidal H, Frayn KN. Insulin-sensitizing effects of dietary resistant starch and effects on skeletal muscle and adipose tissue metabolism. Amer. J. Clin. Nutr. 2005;82(3):559–567.

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