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REGULAR ARTICLE

VARIATION MINERAL COMPOSITIONS OF SOME BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA* (L.) VERDC.) ACCESSIONS

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ABSTRACT

The study aimed to assess variation in mineral compositions of some accessions of Bambara groundnut (*Vigna subterranea* [L.] Verdc.) for domestic use and genetic enhancement. Twenty accessions of Bambara groundnut were planted in a Randomised Complete Block Design (RCBD) with three replications. The five minerals were analysed which include, calcium, magnesium, iron, zinc and manganese. These accessions showed significant ($P<0.05$) variations across the five mineral analysed. Accession no. 18 had the highest mean for iron (2.89 $mg100g^{-1}$), Accession no. 12 had the highest mean value for zinc (0.65 $mg100g^{-1}$) Accession no. 8 had the highest mean value for calcium (217.36 $mg100g^{-1}$), magnesium (14.29 $mg100g^{-1}$) and manganese (0.82 $mg100g^{-1}$). However, accession no. 12 had the lowest mean values in four of the minerals except zinc. This result showed that some of these accessions could be selected for genetic enhancement of minerals, some for domestic use and some for industrial use.

Keywords: Bambara groundnut, Genetic enhancement, Minerals, Accessions

INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L.) Verdc.), also known as 'Okpa' (Igbo), 'gurjiya' or 'kwaruru' (Hausa) and 'Epa roro' (Yoruba) is cultivated mainly for its edible protein-rich seed. Its seeds are known as a complete food because they contain sufficient quantities of protein, carbohydrate and fat [1]. Thus, compared favourably nutritionally when compared with more commonly utilised and commercialised grain legumes. In many African countries, Bambara groundnut serves as a cheap source of protein and minerals of plant origin in areas where animal protein is very expensive [2] for enhanced human nutrition and animal feed.

The major challenge in the utilization of food resources is the lack of adequate information on the nutritional constituents [3]. For example, there are only limited knowledge about under-utilized legumes which are mainly used for human food and animal feeds in Nigeria [4].

The malnutrition is a serious problem in developing countries, due to lack of adequate meat consumption due to high price, making them unaffordable to people of low income [5]. It has been reported that more than 35 % of the world population is manganese deficient [6]. Bambara groundnut may have great potential of sustaining the dietary needs of many people in both rural and urban communities and one of the many legumes that can provide the protein and minerals [2]. Therefore, estimation of its minerals value will provide valuable data for its use as a food and/or medication [7].

MATERIALS AND METHODS

The research was conducted at the Institute for Agricultural Research (IAR) Farm, Ahmadu Bello University, Zaria, (Lat 11 ° 11' N; Long 7 ° 38 ' E and Altitude 660 m above sea level). Samaru lies in the northern guinea savanna agro ecological zone of Nigeria with a mean annual rainfall of about 1200 mm which is essentially between April to September and a mean daily temperature of 27 °C. The coldest months are November-January [8].

Source of materials

Healthy seeds of the Bambara Groundnut accessions were obtained from the local farmers within Giwa (Kaduna State), Kura and Gargai (Kano State) and Hadejia (Jigawa state). The accessions were grouped into twenty (20) groups based on their uniformity in ground colour, eye colour, pattern colour, eye pattern, body pattern and seed sizes.

Sample preparation

Dried seeds for each of the accessions were used for the determination of mineral constituents. Seeds devoid of any pest's damage were ground into fine powder using a small wooden pestle and mortar. The pestle and mortar were cleaned with sponge and water after pounding each accession. Each sample was then sieved through 20 mm

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mesh iron to obtain fine textured flour. Using 1.25 g from each accession, Wet-ashing procedure described by Gorsuch (1959) was employed using nitric acid, perchloric acid and sulphuric acid in the ratio of 3:2:1 with the Kjeldahl apparatus for the digestion.

The minerals determined were: Calcium (Ca), Magnessium (Mg) and the micro-minerals estimated were Iron (Fe), Zinc (Zn) and Manganese (Mn). These mineral concentrations were measured using a Varian Fast Sequential Atomic Absorption Spectrophotometer AA240FS Model. All analyses were carried out in duplicate and the analysis was carried out at the Multi-User Science Research Laboratory, Ahmadu Bello University, Zaria.

The data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS 9.1 version) to determine the significant difference for all the mineral contents. Where significant differences exist, Duncan's multiple range test (DMRT) was used to separate the means at $P<0.05$.

RESULTS

The result obtained in table 1 indicated that there was significant difference at $P<0.05$ in all the mineral compositions of the accessions studied. The highest composition of iron was found in accession no. 19 with 2.89 mg100g^{-1} followed by accession no. 8 with 1.83 mg100g^{-1} and accession 12 with 0.3 mg100g was the lowest. Accession no. 8 had the highest calcium composition of 217.36 mg100g^{-1} while the lowest with 56.76 mg100g^{-1} was accession no. 12. Magnesium composition was found to be highest in accession no. 8 with 14.29 mg100g^{-1} while accession no. 12 with 7.12 mg/100g had the lowest composition. The highest zinc composition 0.65 mg100g^{-1} was found in accession no. 12 followed by accession no. 13 with 0.5 mg100g^{-1} whereas accession no. 7 had the lowest composition of 0.19 mg100g^{-1}. Accession no. 8 with 0.82 mg100g^{-1} had the highest manganese composition while accession no. 12 with mean of 0.29 mg100g^{-1} had the lowest composition.

DISCUSSION

There were significant differences in all the minerals among the Bambara groundnut analysed in this study. These variations in the mineral contents of accessions were also reported by several authors like [2] in different accessions of Bambara groundnut in Botswana, Namibia, Swaziland, and in Congo Brazaville [10]. Similar result was reported in beans (*Phaseolus vulgaris*) by Inobeme *et al.* [11]. The range of the Calcium compositions in the accessions studied is greater than those recorded in Botsawana, Swaziland and Namibia on Bambara groundnut accessions by Amarteifo *et al.* [2], Abdulsalami and Sheriff [12] in Kano, Andzouana *et al.* [10] in Congo Brazaville and those in Cote d'Ivoire [13]. Also, comparing this variations of calcium with other legumes, this study reported a higher composition than accessions of beans [11], groundnut [14], and *Pisum sativum* [15]. However, *Mucuna pruriens* (velvet beans) was reported to have a higher composition of calcium [16]. This indicates that the accessions under study have a great potential as a source of calcium to both humans and animal diets. Calcium functions as a constituent of bones and teeth, in blood and milk clotting, in the functioning of nerves and muscle contraction [4]. The magnesium contents of the accessions do not conform with the reports in different Bambara groundnut accessions by [2] [17] [18] [13], as well as in Brebra seed [19] and in *Pisum sativum* [15] which were found to be low. However, higher amount than what was observed in this study were reported in Bambara groundnut by Andzouana *et al.* [10], *Phaseolus vulgaris* [20] and groundnut [14]. Magnesium plays the role of proper functioning of muscles and central nervous system, enzyme activity, energy production, mineral balances.

Table 1: Mineral compositions (mg100g^{-1}) of 20 accessions of bambara groundnut

ACC	Mineral elements (mg100g^{-1})				
	Fe	Ca	Mg	Zn	Mn
1	1.57^{d}	180.99^{d}	11.00^{g}	0.41^{d}	0.74^{b}
2	0.87^{k}	87.30^{s}	11.08^{f}	0.30^{i}	0.45^{l}
3	0.66^{m}	128.78^{l}	10.23^{l}	0.27^{l}	0.58^{g}
4	1.01^{h}	98.93^{p}	11.26^{e}	0.41^{d}	0.54^{i}
5	0.38^{q}	101.46 ^{o}	10.42^{i}	0.20^{n}	0.41^{m}
6	0.85^{l}	147.88^{h}	12.29^{b}	0.30^{i}	0.61^{f}
7	0.52^{p}	152.48^{g}	9.72^{p}	0.19 ^{o}	0.46^{l}
8	1.83^{b}	217.36^{a}	14.29^{a}	0.49^{c}	0.82^{a}
9	1.02^{g}	92.09^{r}	9.41^{q}	0.35^{h}	0.54^{i}
10	0.64^{n}	117.04^{m}	11.94^{c}	0.26^{m}	0.52^{j}
11	0.62 ^{o}	92.48^{q}	9.78 ^{o}	0.39^{e}	0.61^{f}
12	0.30^{r}	56.76^{t}	7.12^{s}	0.65^{a}	0.29^{n}
13	0.85^{l}	130.04^{k}	10.87^{h}	0.50^{b}	0.56^{h}
14	1.63^{c}	106.74^{n}	10.05^{m}	0.28^{k}	0.49^{k}
15	0.98^{i}	188.49^{b}	10.33^{k}	0.37^{f}	0.68^{d}
16	1.29^{e}	154.61^{f}	11.89^{d}	0.35^{h}	0.70c
17	0.63^{n}	182.13^{c}	10.36^{j}	0.35^{h}	0.68^{d}
18	1.03^{f}	140.19^{j}	8.74^{r}	0.29^{j}	0.54^{i}
19	2.89^{a}	179.72^{e}	10.00^{n}	0.30^{i}	0.59^{g}
20	0.94^{j}	147.82^{i}	10.99^{g}	0.36^{g}	0.63^{e}
SEM±	0.003	0.003	0.004	0.000	0.002

Means with the same letter along a column are not significantly different $P\geq0.05$, using DMRT, KEY: ACC=Accessions, Fe= Iron, Ca= Calcium, Mg=Magnessium, Mn=Manganesse

Reports had also indicated that DNA synthesis is slowed by insufficient magnesium [21]. In view of these, Acc. no. 8 was found to contain both high calcium and magnesium compositions, while acc. no. 12 had the lowest value of both minerals. This may be associated with the presence of phytic and oxalic acids which are anti-nutrients present in Bambara groundnut, most especially those with low concentrations as reported by Adegunwa *et al.* [22] and Yao *et al.* [13]. The nutritional value of legume seeds is often limited by the presence of anti-nutrients, such as tannins, phytic acid and enzyme inhibitors [23]. These antinutritional factors have the ability to bind some divalent metals such as calcium and magnesium thereby interfering with their metabolism [24] [4].

Micronutrients that were determined in this study include iron, zinc and manganesse. Accessions no. 19, 12 and 8 contained substantial amount of source of iron, zinc and manganese, respectively. While accessions no. 12, 7 and 12 had the lowest compositions, in that same order. The status of accession no. 12 which had the low compositions of iron, zinc and manganesse might be inferred due to the presence of phytic acid. However, high compositions of these three micro elements was reported in *Mucuna pruriens* by Vadivel and Janadharnan, [16] in *Phaseolus vulgaris* by Gouveia *et al.* [20] and in Bambara groundnut by Abdusalami and Sheriff[12]. Also, Amarteifo *et al.* [2], Ataise *et al.* [14], Inobeme *et al.* [11] and Yao *et al.* [13] reported higher compositions of iron and zinc than what was found in the present investigation. Furthermore, higher compositions of iron and zinc were reported in this study than those reported by Belewu *et al.* [18] and Andzouana *et al.* [10] in Bambara groundnut and in groundnut by Ayoola *et al.* [25]. Micro minerals even though needed in small quantity, are nevertheless needed for proper body functioning. Manganese is essential for metabolizing fat and protein, and is often related with milk production. Zinc is essential in growth of reproductive organs and oil glands. Iron is very essential for hemoglobin and healthy immune system [4] [26]. In view of the fact that micronutrient malnutrition is a serious problem in developing countries especially infants and pregnant women [27]. Infants need adequate micronutrients to maintain normal growth and development [28]. Observed variations reported in this study might be associated with the accessions' place of origin having an influence on the seeds compositions as reported by Gouveia *et al.* [20]. Therefore, the existence of this range of variability could exploited when selecting for appropriate sources of material for breeding purposes as well as other domestic and industrial use such as formulation of infant formula and animal feed. In accordance with the Recommended Dietary Allowance (RDA), Acc. no. 8 and few other accessions of Bambara groundnut can be selected for domestic use and genetic improvement programme.

CONCLUSION

There was significant variation in the five mineral compositions of the 20 accessions of Bambara groundnut, Accession no. 19 had the highest iron content 2.8 mg/100g. Calcium, magnesium and manganese were found be highest in accession no. 8 (217.36 mg/100g, 14.29 mg/100g and 0.82 mg/100g) respectively. However, accession no. 12 had the lowest contents in calcium, magnesium and manganese and iron (56.76 mg/100g, 7.12 mg/100g, and 0.29 mg/100g and 0.3 mg/100g) respectively but had the highest zinc content 0.65 mg/100g. This result suggest the importance of this accessions in a breeding program that aim at improving crops to meet specific dietary needs as well as instant utilization.

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