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Chemical and Nutritional Composition of Selected Legumes Available in Kebbi State Nigeria

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A B S T R A C T

Legumes are important source of high-quality protein and oil, as well as other nutritious substances. The higher the content of these nutritious substances in a given legume the higher it's quality. The mineral and proximate contents of the variety of legumes available in Mahuta town, were determined using standard procedures. The results showed that legume samples vary significantly ($p < 0.05$) in the chemical parameters evaluated. Soy beans and Ground nut had significantly high concentration of protein than Bambara nut. Equally, Bambara nut and Ground nut shows superiority in carbohydrate composition. Soy bean and Ground nut showed significantly higher concentration of mineral and abundance, while bambaranut had the lowest mineral and lipid contents. Hence, the selected legumes evaluated can serve as alternative protein sources with carbohydrate good minerals, and fibre.

INTRODUCTION

Legumes belong to the family Leguminosae. In the tropics, legumes are the second most important food crops after cereals and are excellent sources of cheap plant proteins and minerals when compared with animal products (Annor et al., 2014). Indigenous legumes therefore are an important source of affordable alternative protein to poor resource people in many developing countries most especially in Africa and Asia where the grains constitute part of the daily staple food. Legumes have a special place in the diet of humans, because they contain nearly 2–3 times more proteins than cereals depending on the type (Reyes-Moreno et al., 1993; Annor et al., 2014). Legumes are also excellent sources of complex carbohydrates which have been reported as beneficial for the prevention and management of cardiovascular diseases and diabetes. They also serve as a large reservoir of bioactives, most especially the phenolics (Hu, 2003; Enujiugha, 2010). These bioactives have been positively implicated in the treatment and management of degenerative diseases (Silva et al., 2007; Singh et al., 2017). Furthermore, they are also a good source of vitamins (thiamine, riboflavin, niacin, vitamin pyridoxine and folic acid), minerals (calcium, iron, copper, zinc, phosphorus, potassium and magnesium) and are excellent sources of PUFA (linoleic and linolenic acids) (Ade-Omowaye et al., 2015; Molendi-Coste et al., 2011; Vadivel and Janardhanan, 2005).

Groundnut, Arachis hypogaea L, is an important oil crop of Brazilian origin, is cultivated in tropical and warm temperate climates. The crop is grown usually as a component of a variety of crop mixtures including sorghum, millet, cowpea and maize (Musa et al., 2010). Groundnut is an important oil seed and cash crop accounting for more than one-third of the total oil seed production in Nigeria (Musa et al., 2010).

Bambara nut (Vigna subterranea (L). Verdc) belongs to the family of leguminosae and had been known to originate in the Sahel region, presently West Africa. The name 'Bambara' had been thought to have come from the tribe Bambara in Timbuktu area of Central Mali (Heller et al., 1997). The crop has now been found cultivated in most West Africa countries like Nigeria, Cameroon, Central African Republic, Chad and the entire tropical Africa. It is found in Southern Africa and Zimbabwe which is now the chief producer of the crop.

One primary source of high-quality protein and oil is the soya bean (Grieshop and Fahey, 2001). In fact, the quality of soya beans is usually determined by seed protein, oil, fatty acid, and mineral contents, as such its quality is key to improving human and animal nutrition. The soya bean, botanically called Glycine max (L.) originated from Eastern Asia, probably in north and central China (Grieshop and Fahey, 2001). Mature soya bean seed contains approximately 40% protein, 20% oil, and 10% water-soluble carbohydrates (Kuo et al., 1996) Glycine max is an important legume increasingly consumed for both its nutritional and economic values (Garcia et al., 1997; Henley et al., 1993; Steinke, 1992). This importance is probably related to the fact that soya bean products are excellent sources of proteins, minerals, phosphorus, and vitamins all at a very low-cost (Garcia et al., 1998).

LITERATURE REVIEW

To be able to feed the rapidly increasing population in Nigeria, there is need to nutritionally characterize lesser known legumes. Nah and Chau (2010) asserted that there are thousand lesser known plant materials that might substantially add to the array of available nutrients most especially the protein need. These lesser known legumes are well adapted to extreme environmental conditions and highly resistant to drought, diseases and pest infestation. Due to their availability and affordability, hence, the need for such plant materials to be nutritionally characterized for the benefit of human kind most especially in the third world countries where adequate protein intake is a major problem. In that regard, research studies have been ongoing in presenting lesser known legumes and their suitability in different food applications. Fasoyiro et al. (2006) assessed the proximate, mineral and antinutrient composition of four lesser grains found in Nigeria. The result revealed 22–37% protein, implying their potential in fighting protein deficiencies. The antioxidant properties of some commonly consumed and underutilised legumes in Nigeria were reported (Oboh, 2006). The result revealed high antioxidant and reducing power comparable to known legumes such as soybean. Ade-Omowaye et al. (2015) studied the nutritional potential of nine underexploited legumes in southwest Nigeria. The finding revealed high protein in Mallotus subulatus (red variety). While, James et al. (2016) assessed the potentials of protein concentrate from seven legumes indigenous to northern Nigeria for different food applications. The result of the finding showed that, the concentrate has the functionality to be incorporated into different food systems. There is need to investigate other lesser known legumes with dearth of scientific data, hence, the thrust of this study. Therefore, this study evaluated the proximate, minerals, fibre, fatty acids and amino acids compositions of eight lesser known legumes in Nigeria. There proper knowledge would establish their potentials as alternative food sources in counteracting malnutrition.

METHODOLOGY

Materials and Methods

Collection and Preparation of the Samples

Samples each of groundnuts, Bambara nuts and Soybeans were obtained from farmers in Mahuta town, Fakai Local Government Areas of Kebbi State. The seeds were handpicked to remove extraneous materials. They were soaked in water to remove shaft after which it was dried and grounded into a fine powder using an electric mill.

Analysis of the samples

The standard methods of the Association of Official Analytical Chemists (AOAC, 1990) were used to determine moisture, ash, crude fat and crude protein content. Moisture content was obtained by heating three 5.0 g portions of the three samples differently in an oven (Gallenkamp QC, England) at 110°C until a constant weight was obtained. Ash determination was obtained by the incineration of three 3.0 g samples in a muffle furnace at 600°C for 3 h when a light-grey ash was produced. Crude protein (CP) was obtained using three 3.0 g portions of the samples. The CP was calculated by a multiplying factor (%N × 6.25). The crude fat (CF) was determined by extraction procedure using three 5.0 g samples in a Soxhlet apparatus using petroleum spirit (bp 40 - 60°C) as the solvent.

RESEARCH RESULT AND DISCUSSION

Data analysis

Data were subjected to analysis of variance and the different means were separated using Student-Newman-Keuls (SNK) test.

Table 1. . Proximate composition of legume samples

Parameter	Groundnut	Bambara nut	Soya beans
Moisture (%)	12.75 ± 0.00	7.78 ± 0.025a	8.07±0.00
Ash (%)	9.82 ± 0.01	3.76 ± 0.00	4.61±0.03
Crude fibre (%)	6.11 ± 0.01	5.48 ± 0.04	6.84±0.01
Protein (%)	29.34 ± 0.01	20.44 ± 0.00	37.69±0.01
Lipid (%)	23.31 ± 0.01	6.28 ± 0.03	30.31 ±0 .03
Carbohydrates (%)	7.34h ± 0.03	52.80 ± 0.18	5.08 ± 0.02

Values are mean ± standard deviation

Table 1 shows the proximate composition of Groundnut, Bambara nut and Soybeans. The result shows that legumes samples were all significantly ($p < 0.05$) different in the proximate parameters measured. The protein, fat, ash, moisture, fibre and carbohydrate contents ranged from 20.44.25 – 37.69%, 6.28–30.31%, 3.76 – 9.82%, 7.78–12.75%, 5.48 – 6.84% and 5.08 – 52.80 % respectively. Soy beans was found to be significantly ($p < 0.05$) high in protein (37.6.9%), lipid (30.31%), fibre (6.84%). However, it had significantly low carbohydrate (5.08%) compared with other legumes. Ground nut ranked next to groundnut in protein, and crude lipid. Bambaranut was found to be significantly ($p < 0.05$) low in protein (20.44%), lipid (6.28%) ash (3.76%) and moisture (7.78%), however, it was found to be significantly ($p < 0.05$) high in carbohydrate (52.80%) in comparison with other legume samples.

Table 2. Mineral Composition of Legume Samples

Minerals mg/100 g	Groundnut	Bambara nut	Soybeans
Calcium	215.64 ± 0.02	172.32 ± 0.17	200.36 ± 0.02
Magnesium	195.92 ± 0.03	118.53 ± 0.07	258.24 ± 0.03
Potassium	1183.65 ± 0.04	800.53 ±0.12	607.20 ± 0.03
Phosphorus	695.75 ± 0.04	121.65 ± 0.11	350.20 ± 0.02
Sodium	300.53 ± 0.03	160.65 ± 0.09	320.40 ± 0.03
Manganese	95.39 ± 0.04	28.26 ± 0.01	20.00 ± 0.02
Iron	17.93 ± 0.03	4. 00 ± 0.01	16.40 ± 0.02
Cupper	11.80 ± 0.04	2.36 ± 0.01	3.60 ± 0.003
Zinc	40.40 ± 0.03	13.20 ± 0.04	0.15 ± 0.02

Values are mean ± standard deviation

The results show that the three (3) legumes evaluated vary considerably in all the mineral elements determined. Groundnut had significantly ($p < 0.05$) high Ca, Fe, K, P, Cu, Mn, and Zn except in sodium (Na) where, Soy beans had the highest value. The trend of mineral abundance in the legumes can be summarized thus: groundnut > Soybean > Bambara nut. Potassium (K) was the most abundant macroelement in all the legume samples evaluated. The values ranged from 1183.65 mg/ 100 g to 607.20 mg/ 100 g in groundnut and soy bean, respectively. Legume samples evaluated have appreciable abundance of other macro elements Ca, Mg, Na and P. Their values ranged from 215.64 – 172.32 mg/100 g, 258.24 – 195.92 mg/100 g, 320.40–160.65mg/100 g and 695.75–121.65 mg/100 g, respectively. Mn is the most abundant trace element determined in the legume samples. The values ranged from 95.39 to 20.00 mg/100 g in groundnut and soy beans, respectively. Other trace elements Fe, Cu and Zn were present in appreciable quantities ranging from 17.93 – 4. 00 mg/100 g, 11.80–2.36 mg/100 g and 40.40 and 0.15 mg/ 100 g, respectively. Calcium (Ca) is the most abundant macro element in the human body. In conjunction with phosphorus, they play a role in the process of teeth and bone formation, muscle physiology as well as in the mechanism of blood coagulation (Cormick and Belian, 2019; Miller et al., 2017). The Ca content ranged from 215.64 – 172.32 mg/100 g, while for phosphorus the content ranged from 695.75 – 121.65 mg/100 g. Groundnut in comparison with other legumes showed superiority in Ca abundance (215.64 mg/100 g). The result of this study agrees with the finding of Settaluri et al. (2012). The Ca content of ground nut (215.64 mg/100

g) and Bambara nut (172.32 mg/100 g), the second and third legumes in Ca abundance are in line with the findings of Akindahunsi (2004). Magnesium (Mg) is an essential macro element needed for normal muscle and nerve functions; regulation of normal blood pressure and blood glucose level and an important element in teeth and bone formation (Grober et al., 2015 ; Schwalfenberg and Genuis, 2017). Legumes evaluated have high magnesium content with high abundance in soy beans (258.24 mg/100 g) and low abundance in bambaranut (118.53 mg/100 g). Potassium (K) is an important element which helps in maintaining body fluid electrolytes balance. In association with sodium ions, potassium plays an important role in the brain and nerve functioning and in muscle development. The range determined 1183.65 – 607.20 mg/100 g shows that all the legume samples are good food sources. The value in Bambara nut (1183.65 mg/100 g) is high compared with 50.70 mg/100 reported by olaleye et al., 2013. The variations in the mineral contents can be attributed to species differences and source of water during analysis. Legume samples have considerable amount of iron ranging from (17.93 - 4. 00mg100 g). This shows that all the legumes evaluated are potential sources of iron when consumed in sufficient quantity. Therefore, they can serve as important tools in fighting iron deficiency most especially in the developing countries. Copper and zinc are important trace elements which play vital roles in the body during metabolisms. They serve as cofactors to a number of key metabolic enzymes (Mustafa and AlSharif, 2018; Uauy et al., 1998). Also, they play important roles in normal growth and development during pregnancy, childhood and adolescence. Their values ranged from 11.80 – 2.36 mg/100 g and 40.40 – 0.15 mg/100, respectively. The results reveal that lesser legumes under investigation are potential food sources of Cu and Zn. This implies that, the legumes are capable of supplying over 70% and 50% of daily human need of copper and zinc, respectively.

CONCLUSIONS AND RECOMMENDATIONS

The study has established that the variety of legumes grown and marketed at Mahuta, Fakai local government in Kebbi state, Nigeria, contains considerably high content of nutritional and mineral composition. These legumes can be useful in areas where these minerals are deficient in the diet. These findings underline the importance of this indigenous and underutilized legume in a continent with rampant famines and malnutrition.

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