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Chemical Composition of Groundbean Based Cocoyam, Yam and Plantain Pottage Dishes and Roasted Groundbean

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Abstract: Chemical composition of pottage dishes based on Groundbean (GB) and roasted GB as eaten were investigated using standard methods. Results showed that cocoyam-GB pottage had higher protein value (3.70%) than yam (2.10%) and plantain-GB dishes (2.82%).The ash, fat and fibre levels in yam-GB pottage were more (0.99, 27.23 and 4.70%, respectively) than other dishes and the roasted GB ($p<0.05$). The plantain-GB pottage contained more carbohydrate (46.49%) than other pottage dishes and higher energy than all others. Roasted GB however, contained comparatively higher protein (14.00%), carbohydrate (68.68%) and most mineral element values than the pottage dishes ($p<0.05$). However, cocoyam-GB pottage had higher values for zinc and iodine ($p<0.05$) and relatively more antinutrients than all others with the exception of oxalate which was present in only roasted GB. The findings suggest that these dishes would greatly contribute to total daily nutrient intake of consumers and add to local food composition table data bank.

Key words: Groundbean, roasted groundbean, pottage dishes

INTRODUCTION

Plant foods are the most important dietary sources for meeting the nutritional needs of majority of the population of Nigeria. Legume seeds are an important part of human diet in many countries through out the world, particularly in tropical and sub-tropical areas (Koehler *et al*., 1981). In Nigeria, however, the common food legume according to Ezedinma (1989) is cowpea (*Vigna unguiculata*). Groundbean (*Kerstingiella geocarpa Harm*) is a lesser known and underutilized grain legume crop. It originated in the savanna areas of West Africa and has a very restricted range of cultivation being confined to tropical Africa, particularly Nigeria, Mali, Burkina-Faso, Upper Volta, Niger, Benin and Togo (Kay, 1979; Obasi and Agbatse, 2003), where it is grown at subsistence level. Obasi (1989) remarked that the major militating factor in the production of groundbean is lack of knowledge of factors that affect its growth, development and yield.

The mature seeds can be boiled or ground into a paste similar to other grain legumes such as cowpea. The paste is used in the preparation of moi-moi (steamed bean cake) and akara (fried bean balls). The seeds can be eaten alone or combined to complement cereals, roots and tubers. They can also be roasted and eaten with coconut or palm kernel (Chikwendu, 2003).

Groundbean has a high nutritional value and comparable to that of most commonly eaten legumes. NAS (1979) reported crude chemical composition of the seed in 100 g portion as follows: protein 21.5 g, fat 1.2 g, fibre 6.1 g, ash 3.6 g carbohydrate 73.9 g and calories 386. However, higher crude protein (24.9%) than the protein values of under-exploited legume crops have been indicated (Obasi and Agbatse, 2003).

The major minerals content of the seed were 1.25 g potassium, 2.14 g calcium, 0.40 g magnesium, 3.32 g phosphrus and 0.87 sodium per kilogramme. The trace mineral content were 14 mg zinc, 122 mg iron and 3 mg copper per kilogramme (Obasi and Agbatse, 2003).

Chikwendu (2007), observed low anti-nutrients values in groundbean which compared with those observed in chickpea, blackgram, mungbean and pigean pea (Sathe, 1996). Trypsin Inhibitor (TI) levels in four varieties of groundbean ranged from 0.24-0.31 mg. The tannins values ranged from 0.48-0.55 mg. Phytate values ranged from 0.13-0.21 mg. Oxalate levels ranged from 0.07-0.17 mg, saponin values were from 0.10-0.15 mg and cyanide levels ranged from 0.16-0.19 mg (Chikwendu, 2007). The chemical composition of groundbean indicates that it could provide valuable nutrients to its consumers because it is low in antinutrients which compares with the values of other commonly eaten legumes. There is need for nutritionists, dietitians and consumers to know the chemical composition of our indigenous foods to help in food planning and selection. Ihekoronye and Ngoddy (1985) reported that malnutrition would be curbed if indigenous food production capacity and knowledge of its nutritional value improves.

This work determined the chemical composition of groundbean cocoyam, yam, plantain pottage dishes and roasted groundbean as consumed.

MATERIALS AND METHODS

Groundbean (GB) seeds were bought from Nrobo market in Uzo-Uwani L.G.A of Enugu State where it is commonly grown. Cocoyam (achicha-ede) was bought from Nsukka also in Enugu State. Yam and plantain were bought from Umuahia main market in Abia State, all in Nigeria.

Dishes prepared from Groundbean (GB)

GB and achicha-ede: Achicha-ede (cooked dried cocoyam) was broken to pieces using mortar and pestle, soaked in water for about 4 h washed severally and drained. The cleaned achicha was put into a rafia basket (local steamer) and placed over the cooking GB that has been boiling containing small amount of water. Groundbean and achicha-ede were cooked for about 2 h till tender.

Sauce was prepared in another pot. Oil was first heated, onions added, then pepper and salt to taste. The cooked GB and achicha-ede were put into the sauce and mixed thoroughly. Sliced fermented oil bean seeds (ugba) was added to garnish the meal and served hot.

GB and yam: Yam was peeled, washed and cut into slices. GB was allowed to cook till almost soft and yam was added. When yam was cooked, it was removed and mashed coarsely. Mashed yam, cooked GB and ugba were added to the already prepared sauce, mixed well and served hot.

GB and plantain: Plantain was peeled, washed and cut into pieces. Groundbean was cooked till almost tender and plantain added to cook. Cooked plantain was removed and mashed coarsely. Mashed plantain, cooked GB and ugba were put into prepared sauce, mixed well and served hot.

Roasted GB: Washed GB was put into frying pan, little water and pinch of salt (optional) were added. GB was stirred steadily and allowed to pop for sometime. After frying, water was sprinkled on it to soften it and served. Roasted GB could be eaten with palm kernel or coconut.

Chemical analysis: The proximate composition of the food samples were determined using AOAC method (1995). Carbohydrate was determined by difference. Iron, calcium, sodium, copper, manganese, magnesium, zinc, phosphorus, potassium and iodine were determined using atomic absorption method (AOAC, 1995). Phosphorus and iodine were estimated spectrophotometrically. Trypsin inhibitor was determined by the method described by Kakade *et al.* (1974) and trypsin inhibitor activity expressed as TI mg/g sample. Phytate was estimated by modified method of Latta and Eskin (1980). Oxalate was determined by the method described by Oke (1978) and cyanide was determined enzymatically using the method of Cooke (1978).

Statitically analysis: Data collected on chemical analysis of the dishes were analyzed using computer programme Statistically Software Package (SAS, 2003). Standard Error of the Mean (SEM) and Least Significant Difference (LSD) were used to separate the mean differences among samples ($p<0.05$).

RESULTS AND DISCUSSION

Chemical evaluation of pottage dishes based on groundbean: Table 1, presents proximate composition of dishes based on GB. The moisture values differed. The cocoyam/GB and yam/GB pottage dishes had higher moisture (55.67 and 57.61%) over that based on plantain (21.15%) ($p<0.05$). The roasted GB had the least moisture which is expected (9.81%) ($p<0.05$). The protein content of the dishes ranged from 2.10-14.00%. The roasted GB had the highest which significantly differed from other dishes (14.00%) ($p<0.05$). The cocoyam/GB dish had higher protein than those of yam/GB and plantain/GB (3.70 vs 2.10 and 2.82%) ($p<0.05$).

Ash values were lower than 1.00%. The range was from 0.30-0.99%. The yam/GB and plantain/GB dishes had 0.99 and 0.80% ash which were different from other dishes ($p<0.05$). The cocoyam/GB pottage had lowest ash ($p<0.05$) than other dishes. Fat levels ranged from 4.50-27.23%. The yam/GB dish had higher fat (27.23%) than cocoyam/GB and plantain/GB dishes (26.17 and 26.04%) ($p<0.05$).

Fibre values ranged from 2.65-4.70%. The plantain/GB and roasted GB dishes were comparable (2.70 and 2.65%) ($p>0.05$). The cocoyam based dish had higher fibre than those of plantain/GB pottage and roasted GB (3.60 vs 2.70 and 2.65%) ($p<0.05$). The Carbohydrate (CHO) content of the dishes depended on moisture. The lower the moisture value the higher was the CHO composition. The roasted GB had higher CHO (68.68%). The yam/GB dish had the least CHO (7.37%) which was much lower than other dishes ($p<0.05$). Cocoyam/GB dish had 10.67% CHO. The plantain/GB dish had more CHO than those of cocoyam or yam ($p<0.05$). Energy levels of the dishes were a function of both moisture and CHO. The plantain/GB dish and roasted GB had higher energy than those of yam and cocoyam GB pottage dishes (1812.72 and 1557.61 vs 1230.62 and 1188.39KJ) ($p<0.05$).

The lower moisture (21.15 and 9.81%) for plantain/GB pottage dish and roasted GB showed they would have a longer keeping quality than those of cocoyam and yam. Low moisture foods have less chances of developing mould to spoil the foods (Ihekoronye and Ngoddy, 1985) (Table 1). The higher protein for roasted GB (14.00%) demonstrated that roasted GB contained more protein as would be expected than others. The lower protein contents of GB, cocoyam, yam and plantain pottage dishes might be due to leaching of some nitrogenous

Table 1: Proximate composition of pottage dishes based on Groundbean (GB) and roasted GB

Composition	Cocoyam + GB	Yam + GB	Plantain + GB	Roasted groundbean	±SEM
Moisture (%)	55.67[b]	57.61[a]	21.15[c]	9.81[d]	±0.049
Protein (%)	3.70[b]	2.10[d]	2.82[c]	14.00[a]	±0.04
Ash (%)	0.30[d]	0.99[a]	0.80[b]	0.45[c]	±0.007
Fat (%)	26.17[b]	27.23[a]	26.04[b]	4.50[c]	±0.018
Fibre (%)	3.60[b]	4.70[a]	2.70[c]	2.65[c]	±0.031
CHO (%)	10.67[c]	7.37[d]	46.49[b]	68.68[a]	±0.055
Energy (KJ)	1230.62	1188.39	1812.72	1557.61	

Values are means of triplicate samples ±SEM; Means bearing different superscripts in the same column are different (p<0.05)
Cocoyam + GB = Groundbean + Cocoyam dish; Yam + GB = Groundbean + Yam dish;
Plantain + GB = Groundbean + Plantain dish Roasted Groundbean = Roasted Groundbean

compounds into the processing media (Abulude, 2004). On the other hand, higher protein for cocoyam/GB pottage suggests that cocoyam had more protein than yam and plantain. The higher ash for yam and plantain/GB pottage dishes (0.99 and 0.80%) suggests that yam and plantain have more mineral than cocoyam. The least fat (4.50%) for roasted GB is not a surprise. During roasting, both animal and plant foods loose fat. This is because heat due to roasting extracts fat from its organic complexes. The extracted fat drips into roasting equipment (pan). The lower fibre for roasted GB means that it might not evacuate digestive mass as fast as those dishes containing high fibre. It is known that dietary fibre quickens bowel evacuation and might reduce the risk of developing colon cancer (Anderson, 1985; 1986). The highest Carbohydrate (CHO) for plantain/GB pottage and roasted GB showed that plantain had higher carbohydrate value than cocoyam or yam/GB pottage. The high carbohydrate value for plantain/GB pottage and roasted GB might be due to their low moisture and fibre contents. The higher loss of moisture could have precipitated increase in dry matter of which CHO is included or among. Roasted GB had higher protein, CHO and lower moisture and fibre in agreement with the findings of Ezeokonkwo (2005) who reported increased levels of crude protein and CHO and reduction in crude fibre and fat in roasted Terminalia catappa L. seed. Energy composition of dishes was a function of fibre, moisture and CHO contents.

Table 2 shows the mineral content of the pottage dishes and roasted GB. The iron values for cocoyam/GB and yam/GB dishes were lower than those of plantain/GB and roasted GB ($p<0.05$). The yam/GB pottage had higher Ca than those of cocoyam and plantain ($p<0.05$). The roasted GB had significantly higher Fe, Ca and Na values than other dishes ($p<0.05$). Copper values differed. Plantain/GB dish had highest Cu (5.35 mg) than the other dishes ($p<0.05$). The cocoyam, yam and roasted GB had least values (0.90, 1.07 and 1.38 mg, respectively) which were much lower than that of plantain ($p<0.05$). Plantain had significantly lower Mn level than other dishes of cocoyam, yam and roasted GB (2.00 vs 7.59, 5.26 and 7.86 mg, respectively) ($p<0.05$). Magnesium levels were lower in cocoyam and yam dishes. The roasted GB also had higher Mn and Mg values ($p<0.05$).

Zinc values differed among the dishes. The range was from 12.55-15.87mg. The cocoyam/GB dish had the highest zinc (15.87 mg) ($p<0.05$) than those of yam and plantain. The yam/GB and the roasted GB dishes had similar values ($p>0.05$). The plantain/GB had the least (12.55 mg) ($p<0.05$). Potassium values differed. The plantain/GB dish had the least (4.34 mg). This value differed from other dishes ($p<0.05$). The roasted GB had highest value (12.48 mg) that differed from others ($p<0.05$). The yam/GB had the second highest value (10.49 mg). This value was much higher than those of cocoyam and plantain dishes ($p<0.05$). Iodine values ranged from 9.38-29.88 mg. The yam dish had the least (9.38 mg) and cocoyam dish highest (29.88 mg) and these differed among other dishes ($p<0.05$). The plantain/GB dish had more iodine than roasted GB dish (17.00 vs 11.32 mg) ($p<0.05$).

The higher Fe content of the roasted GB was not a big surprise. Roasted/baked beans including GB are good sources of Fe. The higher Fe (15.99 mg) for plantain/GB dish than those of cocoyam and yam pottage (13.82 and 5.63 mg) showed that plantain is a better source than cocoyam or yam. On the same explanation, plantain is a better source of Ca (Table 2). The higher Na for the roasted GB might be ascribed to salt added during roasting. The lower Na for the plantain/GB pottage has some nutrition implication. Patients that require Na restricted diet might find this dish useful in management of their health condition.

The lower Cu content of cocoyam/GB and yam/GB pottage dishes (0.90 and 1.07 mg) indicates that both foods are not good sources of Cu. However, the moderate level of Cu in plantain/GB dish demonstrated that plantain is a fairly good source. Many nutrients have foods that are their good or best sources. Cocoyam/ yam GB dishes and roasted GB appear to be better sources of Mn (7.59, 5.26 and 7.86 mg) than plantain/GB pottage (2.00 mg) (Table 2). On the other hand, plantain and roasted GB are better sources of Mg (11.05 and 12.98 mg) than cocoyam and yam. Plantain/GB pottage had least Zn content than others (12.55 mg). The higher Iodine (I_2) content of cocoyam/GB pottage demonstrated

Table 2: Mineral composition of pottage dishes based on (GB) and roasted GB

Composition	Cocoyam + GB	Yam + GB	Plantain + GB	Roasted groundbean	±SEM
Iron (mg/100 g)	13.82^{c}	5.63^{d}	15.99^{b}	34.35^{a}	±0.02
Calcium (mg/100 g)	5.68^{d}	15.90^{b}	8.27^{c}	25.41^{a}	±0.02
Sodium (mg/100 g)	19.29^{b}	14.36^{c}	9.84^{d}	23.38^{a}	±0.045
Copper (mg/100 g)	0.90^{d}	1.07^{c}	5.35^{a}	1.38^{b}	±0.003
Manganese (mg/100 g)	7.59^{b}	5.26^{c}	2.00^{d}	7.86^{a}	±0.024
Magnesium (mg/100 g)	4.59^{d}	7.38^{c}	11.05^{b}	12.98^{a}	±0.005
Zinc (mg/100 g)	15.87^{a}	15.03^{b}	12.55^{c}	15.16^{b}	±0.014
Potassium (mg/100 g)	6.75^{c}	10.49^{b}	4.34^{d}	12.48^{a}	±0.006
Iodine (mg/100 g)	29.88^{a}	9.38^{d}	17.00^{b}	11.32^{c}	±0.022

Values are means of triplicate samples ±SEM; Means bearing different superscripts in the same column are different ($p<0.05$)
Cocoyam + GB = Groundbean + Cocoyam dish; Yam + GB = Groundbean + Yam dish
Plantain + GB = Groundbean + Plantain dish; Roasted groundbean = Roasted Groundbean

Table 3: Antinutrients content of pottage dishes based on (GB) and roasted GB

Composition	Cocoyam + GB	Yam + GB	Plantain + GB	Roasted groundbean	±SEM
Tannins (mg/100 g)	0.16^{a}	0.13^{b}	0.10^{c}	0.11^{c}	±0.005
Phytate (mg/100 g)	0.22^{a}	0.11^{c}	0.21^{a}	0.15^{b}	±0.006
Trypsin (TU/100 g)	2.35^{a}	1.75^{b}	1.26^{d}	1.44^{c}	±0.006
Oxalate (mg/100 g)	0.000	0.000	0.000	1.05^{a}	±0.000
Cyanide (mg/kg)	0.87^{a}	0.24^{b}	0.17^{c}	0.19^{c}	±0.010

Values are means of triplicate samples ±SEM; Means bearing different superscripts in the same column are different ($p<0.05$)
Cocoyam + GB = Groundbean + Cocoyam dish; Yam + GB = Groundbean + Yam dish
Plantain + GB = Groundbean + Plantain dish; Roasted groundbean = Roasted Groundbean

its superiority as source of I_2 over other dishes (29.88 vs 9.38, 17.00 and 11.32 mg) ($p<0.05$).

Table 3 presents the antinutrients content of GB based dishes. Tannins concentrations ranged from 0.10- 0.16 mg. Cocoyam and yam/GB dishes had first and second highest values (0.16 and 0.13 mg) which differed from those of plantain and roasted GB (0.16 and 0.13 vs 0.10 and 0.11 mg) ($p<0.05$). Phytate values ranged from 0.11-0.22 mg. Yam/GB dish had significantly lower value than the other dishes ($p<0.05$). However, the cocoyam and plantain GB dishes had comparable values (0.22 and 0.21 mg) ($p>0.05$). Trypsin inhibitor levels ranged from 1.26-2.35 TU. Cocoyam/GB dish had highest value which differed from the other dishes (2.35 vs 1.75, 1.26 and 1.44 TU, respectively) ($p<0.05$). Oxalate was not detected in three of the four dishes (0.00 mg). On the other hand, roasted GB had 1.05 mg.

Cyanide concentrations varied. Cocoyam/GB dish had the highest value (0.87 mg) which was higher than other dishes (0.87 vs 0.24, 0.17 and 0.19 mg) ($p<0.05$). Yam/GB dish had the next highest value which was higher than those of plantain and roasted GB (0.24 vs 0.17 and 0.19 mg) ($p<0.05$).

The lower levels of tannins in all the dishes might be attributed to processing or low levels of tannins in the foods naturally. The higher levels of tannins (0.16 mg), phytate (0.22 mg), trypsin inhibitor (2.35 mg) and cyanide appears to suggest firmly that cocoyam had more of these antinutrients than yam/GB and plantain/GB pottage and roasted GB. Traces of oxalate in roasted GB suggest that processing GB by roasting which is dry heat might be the source.

Conclusion: In conclusion, consumption of these dishes considering their nutrient compositions and generally low antinutrient levels would positively contribute to daily nutrient intake.

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