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Quantification of Selected Anti – nutrients and Bioactive Compounds in African Bambara Groundnut (*Vigna subterranea* (L.) Verdc.)

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Abstract Bioactive compounds in plants, being secondary metabolites are important phyto-chemicals, that form the basis of modern pharmacology and medical treatment because it has natural beneficial compounds such as in nutraceuticals, micronutrients e.t.c. Neglected legumes like Bambara groundnut (*Vigna subterranea* (L.) Verdc.) can serve as a high nutrient pulse and also as food supplements. However, despite the fact that Bambara groundnut contains these beneficial bioactive compounds, it also has some compounds, which on the other hand do exists as acute poisons and as contaminants in food, thus implying risks of adverse effects in animals and man. However, the ingested dosage of bioactive plant compounds is often a determinant for a decision as to whether the effect will be beneficial or adverse. Here, the work quantified and reported certain plant bioactive compounds and anti – nutrients in Bambara groundnut (*Vigna subterranea* (L.) Verdc.). The results of some bioactive compounds analysed in this pulse showed that the selected African accession had the highest amount of ascorbic acid of 29.90 mg / 100g in TVSu – 1822, while the least obtained, 11.24 mg / 100g was for TVSu – 1229. Oxalic acid was highest (0.0049 g/g) in TVSu – 1205, and the lowest (0.004 g/g) in TVSu – 1824. The amount of quantifiable cyanogenic glycosides (CNP) in form of hydrocyanic acid (HCN) was highest in TVSu – 1229 with 0.34 mg / 100g, and the least in accessions TVSu – 1824, TVSu – 553, TVSu – 1727 and TVSu – 922 with 0.05 mg / g. Also, the highest amount of trypsin inhibitors of 18.97 mg / g was found in TVSu – 174, while the least amount of 0.07 mg / g was found in TVSu – 1727.

Keywords: *plant bioactive compounds, anti – nutrients, pulse, Bambara groundnut*

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1. Introduction

Bambara groundnut is a very important and nutritious legume, especially among the poor of developing countries. This legume is considered a balanced diet food, with a carbohydrate and protein content of approximately 65% and 18% respectively, in addition to other important nutrients and anti – nutrients [1]. This makes it a necessary addition to the diets of people who cannot afford expensive animal protein. Because of its nutrition potential, it has been considered to be a complete food, since it has been observed that its consumption by people can make them to survive, even when depending exclusively on it, [1] for all of their nutritional demands. Bambara groundnut has been considered as a 'poor person's crop or a lifesaver, because during the hungry season, the period that exists when the old crops have been eaten and the new crops have not yet been harvested, it is a crop to really depend on for survival. Despite all of these benefits, it remains much as an under-utilised species, even though it has the potentials to be more than just a subsistence crop. The crop is predominant in sub – Saharan Africa and in some part of Asia. Earlier work on some selected African accessions by [2,3] revealed nutrition potentials in some lines, among them are TVSu – 1231, TVSu – 1232 and TVSu – 553, just to mention a few.

Talking about Bambara groundnut consumption, it has been observed that the human body needs these constituents elements and compounds present in its nutrients, which when ingested, digested, absorbed, and circulated through the bloodstream, serves to feed the cells of the body [4,5]. Bioactive compounds are secondary plant metabolite, since they are mostly obtained from the biosynthesis of primary plant metabolite such as protein, carbohydrate, fats. e.t.c. Majority of them in Bambara

belong to the class of Plant antioxidants which are composed of a broad variety of different substances like ascorbic acid and tocopherols, polyphenolic compounds, or terpenoids [6,7,8]. They perform several important functions in plants and humans (e.g., carotenoids function as accessory pigments for light harvesting and provide photo-protection and pigmentation in plants). Mono-terpenes and di-terpenes, which are the main components of essential oils, which act as allelopathic agents, attractants in plant-plant or plant-pathogen herbivore interactions or repellants. For humans, carotenoids play an important role in health; for example, carotenoids with pro-vitamin A activity are important for vision; other carotenoids influence the human immune function and gap-junctional communication (GJC) [6]. Additionally, their anti-oxidative capacity is believed to be responsible for the health promoting properties of carotenoids and by extension Bambara groundnut. Three main ways of antioxidant action of carotenoids have been detected until now including quenching of singlet oxygen, hydrogen transfer and electron transfer among others. Some of the anti – nutrients found in Bambara groundnut include some levels of trypsin inhibitor and phenolic compounds, which have been identified in the seed of this pulse [9,10,11]. The trypsin inhibitor is inactivated by autoclaving but was discovered that substantial proportion of the trypsin inhibitor activity remained after heat treatment even though total activity was reduced with the presence of a heat stable (tannin) and heat liable (protein factor). Tannin is located mainly in the seed coat and their concentration is correlated with seed colour as it is in common beans. [12] also found out that the highest level of tannin was present in Bambara groundnut accessions with brown and red seeds; while the lowest tannin level was present in accessions with cream coloured seed, but nearly all the accessions are all having very low level of cyanogenic glycoside in form of hydrocyanic acid (HCN).

Figure 1. Some sources of plant bioactive compounds (Strawberries, Myzus persicae, Bambara groundnut and Leaf of cucumber

2. Materials and Methods

2.1. Selection and Preparation of Bambara Seed Materials

Twenty (20) accessions of African Bambara groundnut (*Vigna sibterranea* (L.) Verdc) were selected from an initial list of 300 working collection [13], which were originally assembled for initial phenotypic characterisation and assessment, from the global repository, domiciled at the Genetic Resources Centre (GRC) of the International Institute of Tropical Agriculture, IITA, Ibadan, Nigeria, were used for this study. Each of the Bambara seed accession selected were milled into powder in the laboratory using a grinder.

2.1.1. Phytic acid Determination

For the analysis of phytic acid, a 2g each of the powdered Bambara groundnut samples were initially weighed into a 250ml conical flask and soaked for 3hrs using 100ml of 2% conc. HCl, after which they were filtered using a watman filter paper [14,15]. Later on, 50ml of the filtrate were now placed in a 250ml beaker and added to it was 107ml of distilled water, so as to improve its proper acidity and then 10ml of 0.3% ammonium thiocyanate, (NH_4SCN) which serves as an indicator and this was titrated against standard Iron Chloride solution containing 0.00195g Iron / ml until the end-point (brownish-yellow color for 5 min) was reached.

2.1.2. Tannins Determination

For each of the twenty (20) accessions was weighed 1g of the powdered sample into a labeled crucible and agitated in 10ml of distilled water, leaving the residue for 30 minutes at room temperature. These were then centrifuged and 2.5ml of the supernatant were dispersed into a 50ml vaporising flask. Also into another separate 50ml flask, a 2.5ml of standard tannic acid was dispersed, followed with an addition of 1.0ml of folin-dennis reagent and then 2.5ml of saturated sodium bi-carbonate (Na_2CO_3) solution into each flask [16,17]. The mixture were then diluted to 50ml in the flask and incubated for 90 min at room temperature after which the absorbance of each sample was read at 250nm.

2.1.3. Trypsin Inhibitors Determination

To each of the sample, 1g was weighed and added to 50 ml of 0.01N NaOH to extract the sample before adjusting the pH to between 8.4-10 0. The samples were them allowed to stay for 3 hours, stirring them at intervals to maintain the sample in suspension. Thereafter, 1ml of the extract was withdrawn into 33mls of distilled water for dilution. From the diluted extract, 2mls was taken and poured in 3 test-tubes each then 2mls of Trypsin solution were added to 2 test-tubes and left the 3rd test-tube. Also 2mls of distilled water was withdrawn into 3 test-tubes, 2mls of Trypsin solution was added to 2 test tubes and left the 3rd test-tube. The samples in the test-tube were allowed to warm for 10 minutes in the water bath followed with the addition of 5mls of BAPA to all the test-tubes [18,19]. They were later vortexed and warm again for 10 minutes followed by 1ml of glacial acetic acid solution to all the test tubes and 2mls of Trypsin solution to all the 3rd test tubes that does not contain Trypsin solution initially. Samples were later filtered and the absorbance read at 410nm using a spectrophotometer.

2.1.4. Oxalate Determination

The oxalate content of the powdered Bambara groundnut samples was determined using a titration method. Initially, 2 g of each of the labeled samples (20) were placed in a 250 ml volumetric flask suspended in 190 ml distilled water. Then 10ml 6MHCl solution was added to each of the samples and the suspension was later digested at 100°C for 1h. The samples were then cooled and made up

to 250 ml mark of the flask [20]. The suspension samples were then filtered and each of its duplicate portion of 125 ml of the filtrate were later measured into a beaker and four drops of methyl red indicator was added, followed by the addition of concentrated NH4OH solution (drop wise) until the solution changed from pink to yellow colour. Each portion was then heated to 90ºC, later cooled down and filtered to remove the precipitate containing ferrous ion. Each of the filtrate was again heated to 90ºC and 10 ml of 5% $CaCl_2$ solution was then added to each of the 20 samples with a consistent stirring. After cooling, the samples were then left overnight. This was preceded with the solutions been centrifuged at 2500 rpm for 5 minutes. The supernatant were later decanted and the precipitates completely dissolved in 10 ml of 20% H_2SO4. The total filtrate resulting from digestion of 2 g of each of the samples were later made up to 200 ml and its aliquots of 125 ml was now heated until near boiling and then titrated against 0.05 M standardized KMnO4 solution to a pink colour which persisted for 30 seconds. The oxalate content of each sample was calculated.

2.1.5. Cyanogenic Glycosides Determination (CNP)

The method used was alkaline picrate method of [21]. 5 g of each of the 20 samples were added 50 mL distilled water in a conical flask and allowed to stand overnight. To 1 ml of the sample filtrate in a corked test tube 4 ml of alkaline picrate was added and incubated in a water bath for 5 min. The absorbance of the samples were taken at 490 mm and that of a blank containing 1 ml distilled water and 4 ml alkaline picrate solution before the preparation of cyanide standard curve but there was no colour change in any of the corked test tube containing the sample A and B which is the indication of absence of cyanide in the sample i.e., colour changed from yellow to reddish brown after incubation for 5 min in a water bath [22].

2.2. Statistical Analysis

The data were analysed using Statistical Application System (SAS) software, version 9.3. The mean and standard error of means (SEM) of the triplicate analyses of the samples were calculated. The anti-nutrient parameters were separated to determine their level of significance using the tukey's multiple range test at $p<0.05$.

3. Results

Table 1. Showing mean values of the anti-nutrients in Bambara groundnut

		Oxalate		CNP		Trypsin inhibitors.		Phytate		Tannin	
	N	Mean	± Sem	Mean	± Sem	Mean	± Sem	Mean	± Sem	Mean	± Sem
CODE											
TVSu 1202	3	0.00	± 0.00	0.28	± 0.028	10.42	± 0.011	1.80	± 0.017	1.09	± 0.000
TVSu 1205	3	0.00	± 0.00	0.28	± 0.028	10.79	± 0.005	2.07	± 0.017	1.41	± 0.005
TVSu 1218	3	0.00	± 0.00	0.14	± 0.005	18.23	± 0.005	1.95	± 0.017	1.12	± 0.005
TVSu 1229	3	0.00	± 0.00	0.14	± 0.000	9.50	± 0.028	3.28	± 0.023	1.46	± 0.005
TVSu 1231	3	0.00	± 0.00	0.25	± 0.057	9.76	± 0.005	3.20	± 0.023	1.42	± 0.005
TVSu 1232	3	0.00	± 0.00	0.24	± 0.005	10.63	± 0.011	2.98	± 0.040	1.14	± 0.005
TVSu 1235	3	0.00	± 0.00	0.20	± 0.023	9.72	± 0.005	2.03	± 0.040	1.33	± 0.005
TVSu 1373	3	0.00	± 0.00	0.14	± 0.005	12.28	± 0.011	1.87	± 0.017	2.46	± 0.000
TVSu 1727	3	0.00	± 0.00	0.05	± 0.005	8.07	± 0.005	1.85	± 0.005	2.90	± 0.005
TVSu 174	3	0.00	± 0.00	0.14	± 0.005	18.97	± 0.005	1.67	± 0.017	1.28	± 0.005
TVSu 1744	3	0.00	± 0.00	0.14	± 0.005	18.75	± 0.005	1.47	± 0.023	1.07	± 0.005
TVSu 1822	3	0.00	± 0.00	0.14	± 0.005	10.76	± 0.011	1.87	± 0.017	2.22	± 0.000
TVSu 1824	3	0.00	± 0.00	0.05	± 0.005	10.07	± 0.005	1.48	± 0.023	2.40	± 0.005
TVSu 521	3	0.00	± 0.00	0.14	± 0.005	8.16	± 0.005	1.47	± 0.017	2.82	± 0.000
TVSu 553	3	0.00	± 0.00	0.05	± 0.000	10.89	± 0.005	1.80	± 0.017	3.61	± 0.005
TVSu 618	3	0.00	± 0.00	0.05	± 0.005	9.58	± 0.011	1.81	± 0.017	2.51	± 0.005
TVSu 729	3	0.00	± 0.00	0.05	± 0.000	8.16	± 0.005	2.14	± 0.017	2.95	± 0.005
TVSu 887	3	0.00	± 0.00	0.05	± 0.000	10.50	± 0.005	1.88	± 0.023	2.70	± 0.011
TVSu 922	3	0.00	± 0.00	0.05	± 0.000	8.73	± 0.005	2.27	± 0.181	2.63	± 0.011
TVSu 924	3	0.00	± 0.00	0.14	± 0.005	18.49	± 0.005	1.80	± 0.017	1.73	± 0.000

Legend: Data were analysed in triplicates; Data = Mean ± SEM, n=3. Mean values are expressed as mg / 100g for CNP, g/g for oxalate while Tannin, Phytate and Trypsin inhibitors are expressed as mg/g.

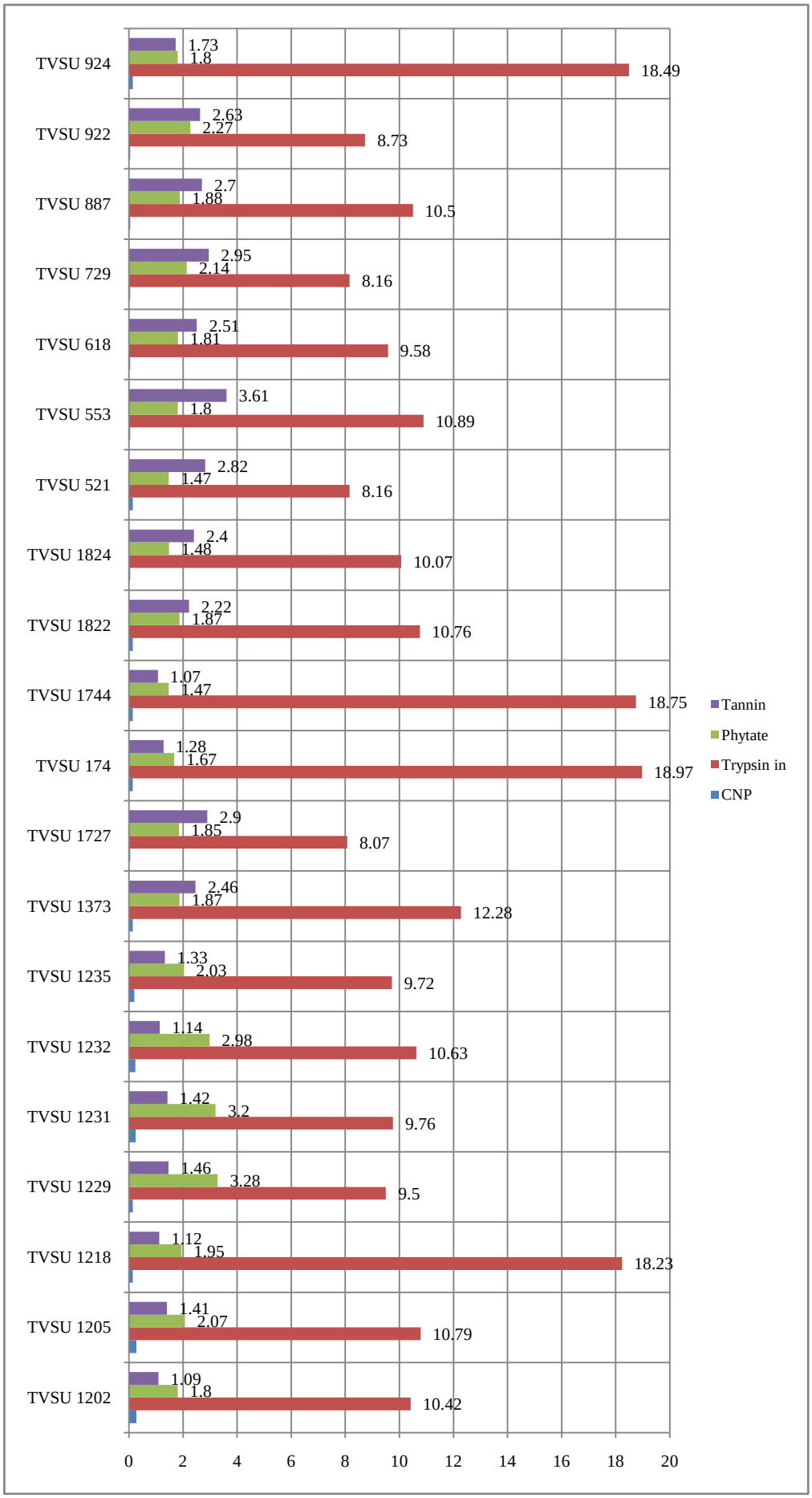

Figure 2. Barchart showing the amount of Tannin, Phytate, Trypsin Inhibitors in (mg/g) and Cyanogenic glycosides (CNP) in mg / 100g among selected African Bambara groundnut.

Table 2. Showing the level of significance in the mean amount of CNP content (mg/100g) among selected African Bambara groundnut accessions

S / N	Accession no	Mean ± Std error	Maximum	Minimum
1	TVSu 1202	0.28 ± 0.028^{a}	0.004	0.003
2	TVSu 1205	0.28 ± 0.028^{a}	0.330	0.230
3	TVSu 1218	0.14 ± 0.005^{b}	0.140	0.130
4	TVSu 1229	0.14 ± 0.000^{b}	0.140	0.140
5	TVSu 1231	0.25 ± 0.057^{a}	0.330	0.140
6	TVSu 1232	0.24 ± 0.005^{a}	0.250	0.230
7	TVSu 1235	0.20 ± 0.023^{a}	0.230	0.160
8	TVSu 1373	0.14 ± 0.005^{b}	0.150	0.140
9	TVSu 1727	0.05 ± 0.005^{d}	0.060	0.050
10	TVSu 174	0.14 ± 0.005^{b}	0.150	0.140
11	TVSu 1744	0.14 ± 0.005^{b}	0.150	0.140
12	TVSu 1822	0.14 ± 0.005^{b}	0.150	0.140
13	TVSu 1824	0.05 ± 0.005^{d}	0.060	0.050
14	TVSu 521	0.14 ± 0.005^{b}	0.150	0.140
15	TVSu 553	0.05 ± 0.000^{d}	0.055	0.050
16	TVSu 618	0.05 ± 0.005^{d}	0.060	0.050
17	TVSu 729	0.05 ± 0.000^{d}	0.051	0.050
18	TVSu 887	0.05 ± 0.000^{d}	0.050	0.050
19	TVSu 922	0.05 ± 0.000^{d}	0.052	0.050
20	TVSu 924	0.14 ± 0.005^{b}	0.150	0.140

Legend: Data were analysed in triplicates; Data = Mean ± SEM, n=3. Values with different superscripts along a column are significantly different ($p < 0.05$) using tukey's groupings on SAS.

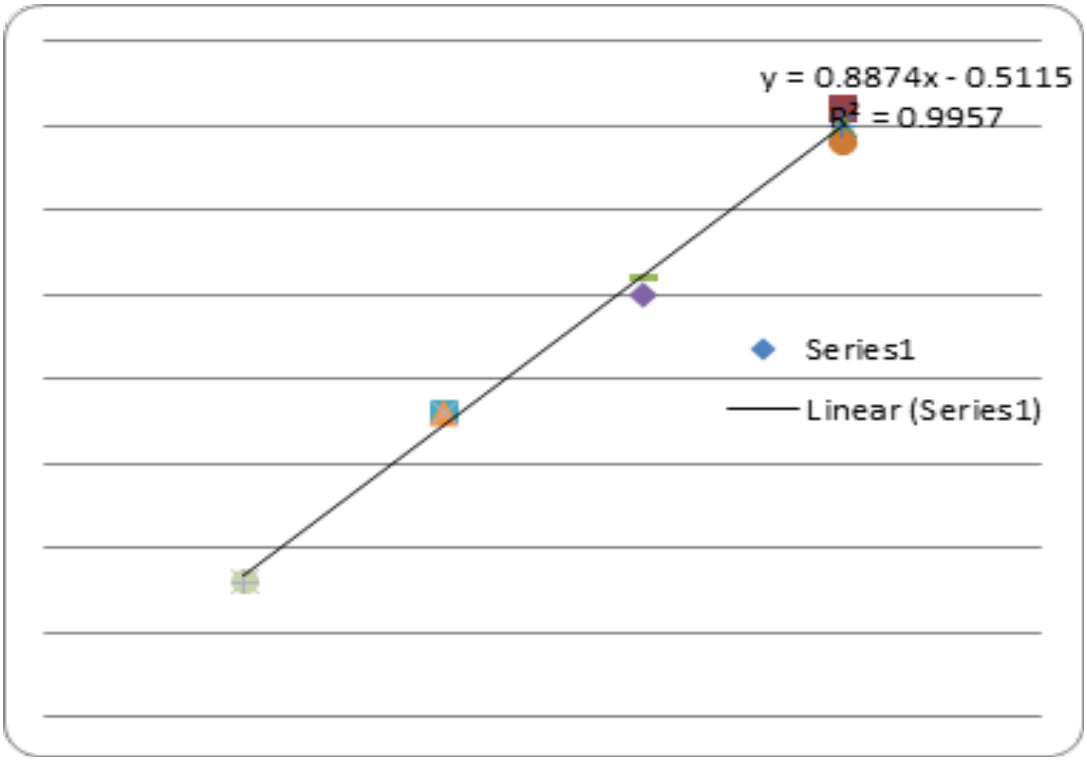

Figure 3. Linear CNP standard plot using Linamarin

Table 3. Showing the level of significance in the mean amount of Trypsin inhibitors (mg/g) among selected African Bambara groundnut accessions

S / N	Accession no	Mean ± Std error	Maximum	Minimum
1	TVSu 1202	10.420 ± 0.011^{j}	10.440	10.400
2	TVSu 1205	10.786 ± 0.006^{g}	10.800	10.780
3	TVSu 1218	18.226 ± 0.003^{d}	18.230	18.220
4	TVSu 1229	9.500 ± 0.028^{n}	9.550	9.450
5	TVSu 1231	9.763 ± 0.003^{l}	9.770	9.760
6	TVSu 1232	10.630 ± 0.011^{h}	10.650	10.610
7	TVSu 1235	9.723 ± 0.003^{l}	9.730	9.720
8	TVSu 1373	12.280 ± 0.011^{e}	12.300	12.260
9	TVSu 1727	8.066 ± 0.003^{q}	8.070	8.060
10	TVSu 174	18.973 ± 0.003^{a}	18.980	18.970
11	TVSu 1744	18.753 ± 0.003^{b}	18.760	18.750
12	TVSu 1822	10.760 ± 0.011^{g}	10.780	10.740
13	TVSu 1824	10.070 ± 0.005^{k}	10.080	10.060
14	TVSu 521	8.163 ± 0.003^{p}	8.170	8.160
15	TVSu 553	10.893 ± 0.003^{f}	10.900	10.890
16	TVSu 618	9.583 ± 0.008^{m}	9.600	9.570
17	TVSu 729	8.163 ± 0.003^{p}	8.170	8.160
18	TVSu 887	10.503 ± 0.003^{i}	10.510	10.500
19	TVSu 922	8.726 ± 0.006^{o}	8.740	8.720
20	TVSu 924	18.493 ± 0.003^{c}	18.500	18.490

Legend: Data were analysed in triplicates; Data = Mean ± SEM, n=3. Values with different superscripts along a column are significantly different ($p < 0.05$).using tukey's groupings on SAS.

Table 4. Showing the level of significance in the mean amount of Phytate content (mg/g) among selected African Bambara groundnut accessions

S / N	Accession no	Mean ± Std error	Maximum	Minimum
1	TVSu 1202	1.798 ± 0.019^{g}	1.830	1.764
2	TVSu 1205	2.071 ± 0.019^{e}	2.105	2.037
3	TVSu 1218	1.945 ± 0.019^{e}	1.976	1.909
4	TVSu 1229	3.275 ± 0.020^{a}	3.312	3.243
5	TVSu 1231	3.203 ± 0.020^{a}	3.240	3.168
6	TVSu 1232	2.976 ± 0.037^{b}	3.044	2.914
7	TVSu 1235	2.034 ± 0.038^{e}	2.103	1.969
8	TVSu 1373	1.874 ± 0.019^{f}	1.909	1.842
9	TVSu 1727	1.845 ± 0.007^{f}	1.860	1.838
10	TVSu 174	1.674 ± 0.019^{g}	1.705	1.639
11	TVSu 1744	1.469 ± 0.020^{h}	1.497	1.429
12	TVSu 1822	1.873 ± 0.019^{f}	1.903	1.837
13	TVSu 1824	1.481 ± 0.020^{h}	1.505	1.439
14	TVSu 521	1.474 ± 0.019^{h}	1.504	1.438
15	TVSu 553	1.797 ± 0.019^{g}	1.829	1.763
16	TVSu 618	1.809 ± 0.019^{f}	1.842	1.775
17	TVSu 729	2.139 ± 0.019^{c}	2.172	2.105
18	TVSu 887	1.881 ± 0.021^{f}	1.905	1.838
19	TVSu 922	2.269 ± 0.196^{c}	2.638	1.970
20	TVSu 924	1.803 ± 0.019^{f}	1.838	1.771

Legend: Data were analysed in triplicates; Data = Mean ± SEM, n=3. Values with different superscripts along a column are significantly different ($p < 0.05$). using tukey's groupings on SAS.

Table 5. Showing the level of significance in the mean amount of Tannin content (mg/g) among selected African Bambara groundnut accessions

S / N	Accession no	Mean ± Std error	Maximum	Minimum
1	TVSu 1202	1.094 ± 0.002^{r}	1.100	1.091
2	TVSu 1205	1.414 ± 0.003^{m}	1.422	1.410
3	TVSu 1218	1.119 ± 0.003^{p}	1.125	1.114
4	TVSu 1229	1.460 ± 0.003^{l}	1.467	1.455
5	TVSu 1231	1.418 ± 0.003^{m}	1.422	1.411
6	TVSu 1232	1.140 ± 0.003^{p}	1.146	1.135
7	TVSu 1235	1.329 ± 0.003^{n}	1.335	1.324
8	TVSu 1373	2.460 ± 0.000^{h}	2.461	2.460
9	TVSu 1727	2.900 ± 0.006^{c}	2.911	2.889
10	TVSu 174	1.279 ± 0.006^{o}	1.289	1.267
11	TVSu 1744	1.073 ± 0.003^{r}	1.080	1.070
12	TVSu 1822	2.218 ± 0.000^{j}	2.220	2.217
13	TVSu 1824	2.398 ± 0.003^{i}	2.402	2.391
14	TVSu 521	2.815 ± 0.002^{d}	2.820	2.813
15	TVSu 553	3.614 ± 0.007^{a}	3.626	3.600
16	TVSu 618	2.509 ± 0.005^{g}	2.520	2.503
17	TVSu 729	2.953 ± 0.008^{b}	2.970	2.945
18	TVSu 887	2.701 ± 0.012^{e}	2.723	2.680
19	TVSu 922	2.634 ± 0.009^{f}	2.648	2.615
20	TVSu 924	1.730 ± 0.000^{k}	1.731	1.730

Legend: Data were analysed in triplicates; Data = Mean ± SEM, n=3. Values with different superscripts along a column are significantly different ($p < 0.05$).using tukey's groupings on SAS.

4. Discussion

The results obtained showed that there are important bioactive compounds and anti – nutrients in Bambara groundnut (*Vigna subterranea* (L.) Verdc.), thus supporting some of the works earlier done by *(Bamisaiye et al., 2011)*. The amount of CNP quantified in the form of hydro-cyanic acid (HCN) in these African accessions of Bambara groundnut (BG) was observed to have a range of 0.05 ± 0.005mg/100g in TVSu – 1727 and TVSu – 1824 to 0.28 ± 0.028mg/100g in TVSu – 1202 and TVSu – 1205. However, some of the values obtained for the CNP in these accessions of BG are statistically significantly different from one another, while a few of them are not significantly different using tukey's classification on SAS program. For example, the amount of CNP in TVSu – 1202 and TVSu – 1205 are not significantly different by tukeys groupings, same with those of TVSu – 1218 and TVSu – 1229 and TVSu – 1231 and TVSu – 1232, while those of TVSu – 174 and TVSu – 1727 are significantly different by tukeys groupings. Also, CNP values for TVSu – 553, TVSu – 729, TVSu – 618, TVSu – 887 and TVSu – 922 are all not significantly different by tukeys grouping, while those of TVSu – 1202, TVSu – 1218, TVSu – 1727 are very significantly different from one another using tukeys classification, while those of TVSu – 924 and TVSu – 521 are not. For the Trypsin Inhibitors (T.I), the range of the quantifiable protease is between 8.07 ± 0.005mg/g in TVSu – 1727 to the highest amount of TVSu – 18.97 ± 0.005mg/g in TVSu – 174. However, the T.I obtained for TVSu – 1205 and TVSu – 1822 are not significantly different from one another, using tukey's classification, while those of the remaining accessions are all significantly different from one another. The amount of Phytic acid in these African accessions of BG ranges from 1.469 ± 0.02mg/g in TVSu – 1744 to 3.275 ± 0.02mg/g in TVSu – 1229. However, the values obtained for phytic acid in TVSu – 1229 and TVSu – 1231 are not significantly different from one another, same with those of TVSu – 924, TVSu – 887, TVSu – 618, TVSu – 1822, TVSu – 1727 and TVSu – 1373. Also, accessions TVSu – 1202, TVSu – 174 and TVSu – 553 had significantly similar phytate values, while those of TVSu – 1231 and TVSu – 1232 are significantly different from one another using tukey's classification on SAS. For the tannic acid results, the amount quantified in these African accessions of BG had a range of 1.073 ± 0.003mg/g in TVSu – 1744 to the highest amount of 3.614 ± 0.007mg/g in TVSu – 553. This showed that the amount of tannin obtained for TVSu – 1215 and that of TVSu – 1232 are non – significantly different from one another. Same with those of TVSu – 1205 and TVSu – 1231 on the one side and TVSu – 1202 and TVSu – 174 on the other; while those of TVSu – 1373 and TVSu – 1202 are significantly different from one another; same with the pairs of TVSu – 1744, TVSu – 1822 and TVSu – 553 and TVSu – 618. Finally, the oxalic acid values obtained for these accessions of African BG are quite interesting. It was observed for the oxalic acid values to be given non – detectable values. The amount of oxalate observed for all the twenty (20) BG quantified was 0.00 ± 0.00g/g, signifying that they are not statistically significantly different from one another using tukey's groupings of classification on SAS program.

5. Conclusion

Bioactive compounds, being secondary metabolites elicits pharmacological, nutritional and toxicological effects in man and animals [6]. It is however important in nutrition to also study the anti – nutrients in plant food as a way of determining the bioavailability or otherwise of important food nutrients. For example, the bioavailability of a higher dosage of phytate will inhibit the absorption of zinc by chelating this and other micro – minerals present in the Gastro Intestinal tract [4]. It was however observed in this work, that apart from trypsin inhibitors, all the other anti – nutrients (CNP, tannin, phytate and oxalate) quantified do not show any potential risks as it concerns the nutrients bio-availability in Bambara groundnut. Infact the amount of oxalic acid quantified and present in Bambara groundnut is negligible and beyond the non – detectable limits. However, the cream colored type of this legume is better recommended for human nutrition and consumption due to a lesser amount of these anti – nutrients. Hence, some of the earlier work by [12,23], can be supported by these findings that this pulse, Bambara groundnut is actually under-utilised, and that more efforts has to be made, to get the much more awareness of its immense nutrition potentials to people, especially of developing countries, so as to enhance its utilisation.

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