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Comparative study on nutritional properties of sixteen commonly consumed varieties of groundnut (*Arachis hypogaea* L.)

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Abstract

A study was conducted to ascertain the nutritional composition of grown groundnut (*Arachis hypogaea* L). The fully developed seeds were harvested individually from groundnut plants cultivated using both inorganic and organic fertilizers as the base, with additional organic fertilizer added throughout different stages of vegetative growth. To facilitate additional examination, the gathered seeds were dehydrated and preserved. An experiment was conducted at the Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN) to assess the nutritional and mineral content of sixteen different cultivars found in Bangladesh. The highest amount of fat (49.57 g/100gm) & β-Carotene (91.80 mg/100g) ware found consequently in V11 (BARI-11) & V13 (Basunti) cultivar. For proximate analysis the highest contains of moisture (3.86 g/100g), ash (4.54 g/100g) & crude fiber (2.54 %) were found respectively in V1 (Dhaka-01), V16 (BINA-08) & V15 (Zinga). On the other hand, for minerals the highest quantity (mg/100g) of Ca (3.44), Mg (0.45), K (0.96), Fe (24.30), Mn (2.40) & Zn (5.70) were obtained consequently from V10 (BARI-10), V15 (Zinga), V16 (BINA-08), V4 (BINA-04), V1 (Dhaka-01) & V4 (BINA-04) cultivar. In the case of genetically assisted breeding of nutrient rich peanuts, the markers associated with nutritional parameters and other important yield related traits may also be used. A contribution to the food composition table is the outcome of this research.

Key-words: Nutrition, Proximate, Mineral, β-Carotene and Groundnut (*Arachis hypogaea* L.).

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops in the world. The crop is important to both small and large industrial growers, and it is widely grown in tropical and subtropical areas. It is classified as both a grain legume and an oil crop due to its high oil content. When it comes to acreage and yearly output, groundnuts represent a substantial oilseed crop in Bangladesh (Biswas et al., 2000; Mondal and Wahhab, 2001) 1.25 million MT of seeds were produced from 0.087 million hectares of cultivation in 2011–12 (Krishi Diary, 2013).

Bangladesh provides only about 40% of the oil used in the nation since its groundnut yields are lower than the average worldwide. Groundnuts are the second-most significant oil seed crop in Bangladesh, taking up 0.076 million hectares of land and producing 1.2 million MT of nuts a year. Increasing this crop's productivity could help alleviate the country's edible oil shortage.

Groundnuts are generally used as ingredients in a limited number of industrially processed meals

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and have little effect on the production of oil. Good human health depends greatly on proper nutrition, which is correlated with diet quality and consumption patterns. Food keeps the body functioning and gives you energy for your everyday activities. In poor nations, the percentage of daily diet fat and protein intake is less than one third and less than two thirds, respectively (Woodroof, 1983). In underdeveloped nations, malnutrition is a persistent issue that affects both adults and children. One strategy to combat malnutrition among the expanding population is to formulate nutrient-balanced foods for the vulnerable. Food crops are more important to daily diets in emerging nations than animal products. Encouragement of the development of highly nutritive crops requires knowledge of the nutritional value of crop products.

According to Savage and Keenan (1994), groundnut seeds are high in minerals like phosphorus, calcium, magnesium, and potassium as well as vitamins A, E, K, and B group. They also contain 44–56% oil and 22–30% protein on a dry seed basis. Globally, groundnuts are cultivated mainly for their oil seeds, which have an oil content of roughly 40%, double that of soybeans (Bansal et al., 1993). Ayoola and Adeyeye (2010) claim that groundnuts are a cheap and high-quality source of oil and protein for diet. Since groundnuts are thought to be a rich source of protein, oil, and minerals, understanding their nutritional worth is crucial when preparing them for use in industry (Ahmed and Young, 1982). Numerous investigations have been carried out to examine the composition of kernels. Groundnut oils' primary fatty acid composition and physical attributes have been studied (Anyasor et al. 2009). Ayoola and Adeyeye (2010) investigated the physico-chemical characteristics of oil crops. The composition of groundnuts grown organically, however, has not been the subject of any scientific investigations or reports.

Nutrients that are helpful to human health are frequently added to peanuts. The components in peanuts that support growth and provide energy make them important from a nutritional standpoint. These consist of purines, some organic acids, proteins, fats, vitamins, and minerals. It is the plant with the highest thiamin (B1) content. In addition to being high in 26 important minerals, groundnuts provide at least 13 different kinds of vitamins. Nuts like peanuts, which are high in protein and vital amino acids, can aid in the prevention of malnutrition. Additionally, peanuts include lipids and carbs, which are high in energy and can help the body meet its fundamental energy needs. The research's goals were to identify the groundnut cultivar that is nutrient-enriched and to quantify the amount of nutrients present.

Material and Methods

The field research work was conducted in the experimental area Araihazar, Narayangonj the head office of BIRTAN. It is situated middle Meghna River floodplain of AEZ-16 in Bangladesh. Located in between 23°40' and 23°53' north latitudes and in between 90°35' and 90°45' east longitudes. Sixteen cultivars (V1= Dhaka-01, V2= Noakhali-1, V3= Noakhali-2, V4= BINA-04, V5= BARI-05, V6= BARI-06, V7= BARI-07, V8= BARI-08, V9= BARI-09, V10= BARI-10, V11=BARI-11, V12=Barisal, V13=Basunti, V14=Tridana, V15=Zinga, V16=BINA-08) groundnut cultivar of Bangladesh. The experiment was in Randomized Complete Block Design (RCBD) with three replications. There were 12 plots. The unit plot size was 2.0 m × 1.0 m = 2.0 m2.

Estimation of proximate composition

The moisture content of the samples was measured in accordance with ASAE guidelines. The triplicate samples were dried in an oven at a temperature of 103 °C for a duration of 72 hours. After drying, the samples were moved to a desiccator and left to cool down to room temperature. Ash content was determined using AOAC techniques. Prior to and during heat treatment (at a temperature of 550 °C for a duration of 12 hours), the samples were measured in terms of weight, and subsequently, the amount of ash present was determined.

The crude fat content was determined using AOAC method 960.39. The specimens were subjected to boiling in a solution of sulfuric acid with a concentration of 0.255 M for a duration of 30 minutes. A precisely measured quantity of 0.313 M sodium hydroxide was utilized to perform

the filtration, washing, and boiling of the resulting insoluble residue. Ultimately, the remaining substance was subjected to a drying process at a temperature of 130 ± 2 °C for a duration of 2 hours. The weight loss was measured at a temperature of 350 ± 25 °C. The amount of dietary fiber in the sample was measured and represented as grams per 100 grams of the sample.

Determination of mineral composition: The specimen was dehydrated at a temperature of 70°C inside an oven for a duration of 24 hours. The dried sample was finely pulverized in a mill. A screen with a thickness of 841 microns was employed to segregate finely ground powder.

The macronutrients (calcium, magnesium, and potassium) and microelements (iron, zinc, and manganese) were evaluated in the final dried and milled powder. The powdered form of grain was subjected to the nitric-perchloric acid digestion procedure to analyze the levels of calcium, potassium, magnesium, iron, manganese, and zinc. In this digesting process, a dried sample weighing 0.5 g was treated with 40 ml of 70% HClO4, 400 ml of 65% HNO3, and 10 ml of 96% H2SO4, in the presence of carborundum beads. Following digestion, the solution was diluted three times in a suitable manner for the purpose of quantifying the element P using the ascorbic acid method. The introduction of ascorbic acid and Sb into the yellow-colored complex solution resulted in the transformation of its hue to blue, forming a phosphomolybdenum complex.

The absorbance was measured using atomic absorption spectroscopy (AAS) at specific wavelengths for different elements: 285.2 nm for magnesium, 766.5 nm for potassium, 248.3 nm for iron, 422.7 nm for calcium, 279.5 nm for manganese, and 213.9 nm for zinc, using the method developed by Temmingh off and Houba. Calibration was performed using AAS standard solutions (1000 mg l−1 in 5% HNO3) obtained from Merck, Germany. Ultimately, the samples and standards were supplemented with lanthanum and cesium chloride (0.1%) to alleviate any potential interferences.

Estimation of carotenoid contents

The sample was extracted using a solution of acetone with a concentration of 80% in order to determine the total amount of carotenoids present. The absorbance at 470 nm for total carotenoids was measured using a spectrophotometer. The data were presented as milligrams of carotenoids per 100 grams of the sample.

Statistical analysis

Replicate samples were combined to get the mean of each replication. The mean values of triplicate samples were subjected to statistical analysis using ANOVA in Statistix 10 software. The means were then compared using Tukey's HSD test at a significance level of 1%. The results were given as the mean of three replications plus or minus the standard deviation.

Results and Discussion

Chemical Composition

The mean chemical compositions of Sixteen varieties of groundnut (*Arachis hypogaea* L.) are presented in Table 1. The lowest ash concentration is found at V14 (3.68%) while the height at V16 (4.54%). The moisture content of 100g is lowest at V9, measuring 3.22%, and highest at V1, at 3.86%. The crude fiber content is lowest at V6, with a value of 2.15%, and highest at V15, with a value of 2.54%. The lowest level of Total Fat is found in V1, with a percentage of 8.56%. On the other hand, the highest concentration is found in V11, with a percentage of 49.57%.

The study's recorded ash contents are somewhat lower than those of Musa et al. (2010) - 3.0-7.4%; they are more in line with the findings of Campos-Mondragon et al. (2009) - 2.0-2.2%; and they are comparable to those of Aslam Shad et al. (2009) - 2.70-3.03%. The disparities noted in the reports seem to stem from variations in the cultivars or types evaluated in each study, as well as shifts in the geographic areas in which the groundnuts were planted. The lowest content of Total Fat (100g) is found in V7, with a value of 15.84mg, while the highest level is found in V13, with a value of 91.80mg. Asibuo et al. (2008), 45.09-51.63%, Aslam Shad et al. (2009), 49.8-53.4%, Campos-Mondragon et al. (2009) and 32.7-53.1% (Musa et al., 2010) are the ranges in which groundnut fat contents have been measured. Our

Table 1. Proximate analysis of various groundnut cultivar.

Cultivars	Ash (g/100g)	Moisture (g/100g)	Crude fiber (%)	Total Fat (g/100g)
V_1	3.81	3.86	2.50	21.14
V_2	4.34	3.57	2.44	18.42
V_3	4.16	3.48	2.46	8.56
V_4	3.96	3.26	2.25	9.58
V_5	4.32	3.71	2.53	39.13
V_6	3.77	3.27	2.15	36.26
V_7	4.22	3.31	2.34	38.48
V_8	4.22	3.71	2.36	29.38
V_9	3.84	3.22	2.29	27.10
V_{10}	4.44	3.42	2.31	17.32
V_{11}	3.86	3.80	2.41	49.57
V_{12}	3.69	3.70	2.33	44.58
V_{13}	4.51	3.43	2.29	37.30
V_{14}	3.68	3.54	2.38	36.20
V_{15}	4.09	3.29	2.54	44.78
V_{16}	4.54	3.45	2.48	30.26
MSE	0.36	0.44	0.26	0.34
F Test	*	NS	NS	**
CV (%)	8.77	12.43	10.95	1.13

Here, V1= Dhaka-01, V2= Noakhali-1, V3= Noakhali-2, V4= BINA-04, V5= BARI-05, V6= BARI-06, V7= BARI- 07, V8= BARI-08, V9= BARI-09, V10= BARI-10, V11=BARI-11, V12=Barisal, V13=Basunti, V14=Tridana, V15=Zinga, V16=BINA-08.

findings show that our values (8.56-49.57%) are within the ranges that have been published in the literature. Groundnuts ' high fat content indicates a high energy density that makes it easier to absorb fat-soluble vitamins without adding to the diet's total volume (Atasie et al., 2009). Groundnut cultivars' fiber content was estimated by Paul and Southgate (1978) to be 6.1%, however Atasie et al. (2009) discovered that it was actually 3.7%. The range noted by Campos-Mondragon et al. (2009) was 3.3–4.4%.

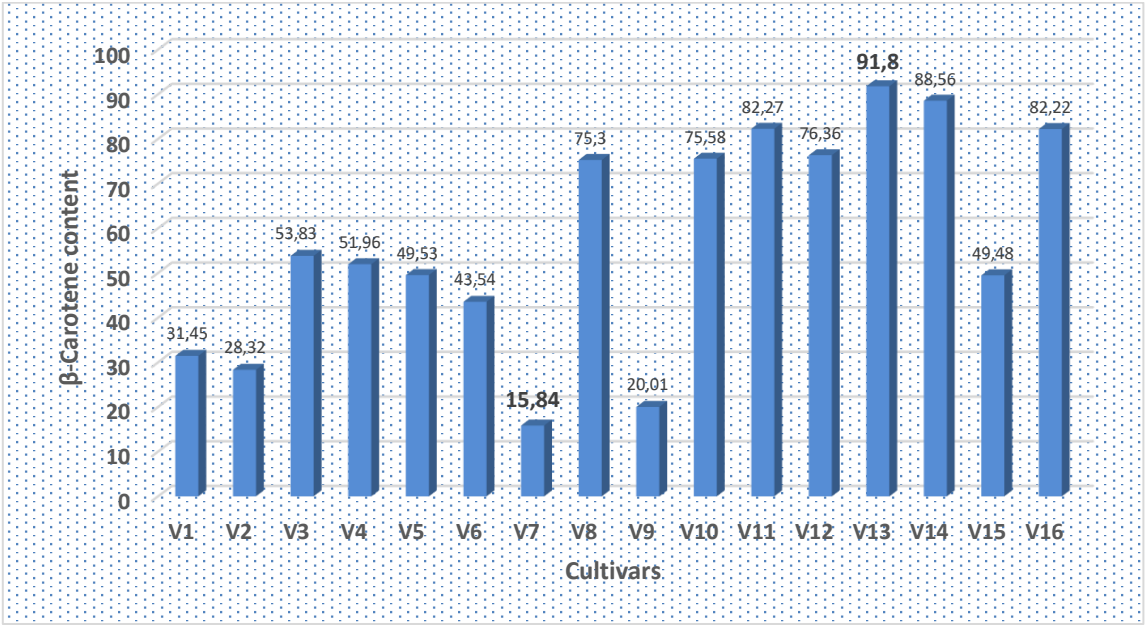
The results of our examination of groundnut cultivars show higher values than the 2.15-2.54% concentration range reported in this study.

Vitamin Composition

The mean concentrations of β-carotene in the sixteen varieties of groundnut (*Arachis hypogaea* L.) are summarized in Figure 1. All of the groundnut genotypes exhibited measurable levels of β-carotene. From this above figure, V7 cultivar contains lowest amount of β-carotene (15.84 mg/100g) and on the other hand V13 cultivar contains highest amount of β-carotene (91.80 mg/100g).

The stated values were expressed on a basis of dry weight. There is a scarcity of data regarding the vitamin levels found in different groundnut types.

Figure 1. β-Carotene content in various groundnut cultivar.



Here, V1= Dhaka-01, V2= Noakhali-1, V3= Noakhali-2, V4= BINA-04, V5= BARI-05, V6= BARI-06, V7= BARI-07, V8= BARI-08, V9= BARI-09, V10= BARI-10, V11=BARI-11, V12=Barisal, V13=Basunti, V14=Tridana, V15=Zinga, V16=BINA-08.

The stated values were expressed on a basis of dry weight. There is a scarcity of data regarding the vitamin levels found in different groundnut types. This result indicates how abundant certain commonly consumed foods are. These micronutrients have the power to give malnourished people—especially those in developing nations – the vital nourishment they need. Owing primarily to their high antioxidant content, nut consumption is associated with a preventive effect against coronary heart disease (Davis et al., 2007).

The boro light variety contains 63.32 mg of β-carotene per 100g, of which 5.28 mg is converted to vitamin A. By contrast, the vitamin A concentration of the almond nut investigated by Christian and Ukhun (2006) is 0.71µg/100g. As antioxidants, vitamin A and tocopherol may help reduce the risk of cancers brought on by free radicals and other potent oxidants (Devlin, 2006).

Vitamin Composition

Nuts have a substantial impact on human nutrition, particularly as valuable sources of vitamins and minerals (Wargovich, 2000). The study presents the average concentrations of the minerals analyzed for the sixteen different groundnut types which is shown in Table 2. The analysis indicates that the samples did not contain any detectable amounts of Co, As, Cd, and Pb.

Other minerals exhibit variation within most kinds. Among all the minerals assessed, the calcium (Ca) content in 100g of the product is the lowest at V9, with a value of 0.73mg, while the highest value for height is V10, with a value of 3.44 mg. The magnesium (Mg) concentration in 100 grams is lowest in V6, with a value of 0.00 mg, and highest in V15, with a value of 0.45mg. The V8 has the lowest potassium (K) level, with 0.42 mg per 100g, while the V15 has the highest potassium content, with 0.96 mg per 100g.

The iron (Fe) concentration is the lowest at 100 g, with a value of 7.20 mg for V16 and a height of 24.30 mg for V4. The manganese (Mn) concentration is the lowest at 100 g, with a value of 1.00 mg for V10 and 2.40 mg for V1. The zinc (Zn) concentration for100 g is lowest at V16 having a value of 2.80 mg and highest value is found at V4 having 5.70 mg. This finding similar to potassium (K), phosphorus (P) and calcium (Ca) closely align with the findings provided by Amarteifio et al. (2006). However, the majority of the minerals are

Table 2. Minerals content in various groundnut cultivar.

Cultivars	Ca (mg/ 100g)	Mg (mg/ 100g)	K (mg/ 100g)	Fe (mg/ 100g)	Mn (mg/ 100g)	Zn (mg/ 100g)
V_1	2.71	0.39	0.63	10.40	2.40	4.20
V_2	1.45	0.22	0.45	8.40	1.60	3.60
V_3	1.73	0.27	0.62	10.80	1.70	4.30
V_4	0.94	0.12	0.69	24.30	2.20	5.70
V_5	1.16	0.25	0.83	16.80	2.00	4.30
V_6	1.02	0.00	0.66	12.10	1.20	3.20
V_7	1.94	0.33	0.89	11.10	1.60	3.50
V_8	2.11	0.36	0.42	9.70	1.70	3.70
V_9	0.73	0.15	0.76	11.80	1.50	2.70
V_{10}	3.44	0.41	0.81	13.20	1.00	3.80
V_{11}	2.41	0.42	0.65	8.87	1.60	3.60
V_{12}	1.98	0.34	0.53	7.30	1.20	3.20
V_{13}	2.71	0.41	0.83	12.80	1.70	3.50
V_{14}	2.30	0.35	0.71	11.20	1.60	3.20
V_{15}	3.06	0.45	0.53	10.80	1.40	3.30
V_{16}	2.17	0.38	0.96	7.20	1.30	2.80
MSE	0.19	0.04	0.10	0.10	0.10	0.10
F Test	**	**	**	**	**	**
CV (%)	9.54	12.37	14.61	0.89	6.23	2.73

Here, V1= Dhaka-01, V2= Noakhali-1, V3= Noakhali-2, V4= BINA-04, V5= BARI-05, V6= BARI-06, V7= BARI-07, V8= BARI-08, V9= BARI-09, V10= BARI-10, V11=BARI-11, V12=Barisal, V13=Basunti, V14=Tridana, V15=Zinga, V16=BINA-08.

lower in comparison to the findings of Asibuo et al. (2008) in their study on 20 enhanced groundnut cultivars. This emphasizes the necessity of allocating resources towards the enhancement, manufacturing and dissemination of enhanced groundnut cultivars for Bangladesh.

From the above correlation Table 3, it shows that, Zn is inversely related with Fat but proportionally related with Fe & Mn. On the other hand, Fe is inversely related with Mg and Mg is proportionally related with β-Carotene & Ca.

Table 3. Pearson's correlation among 11 nutritional traits.

	Total Fat (g/100g)	**β-Carotene (mg/ 100g)**	**Moisture (g/ 100g)**	**Ash (g/100g)**	**Crude fiber (%)**	**Ca (mg/100g)**	**Mg (mg/ 100g)**	**K (mg/ 100g)**	**Fe (mg/ 100g)**	**Mn (mg/ 100g)**	**Zn (mg/ 100g)**
Total Fat (g/100g)	1	0,257	0,188	-0,203	0,070	0,197	0,430	0,060	-0,376	-0,301	-0,549*
β-Carotene (mg/100g)		1	0,289	0,139	-0,023	0,481	0,544*	0,068	-0,132	-0,272	-0,100
Moisture (g/100g)			1	-0,110	0,474	0,270	0,406	-0,325	-0,360	0,340	0,099
Ash (g/100g)				1	0,266	0,261	0,233	0,369	0,002	-0,117	0,031
Crude fiber (%)					1	0,321	0,393	-0,080	-0,289	0,296	0,025
Ca (mg/100g)						1	0,942**	0,008	-0,354	-0,220	-0,161
Mg (mg/100g)							1	0,045	-0,498*	-0,235	-0,293
K (mg/100g)								1	0,223	-0,076	-0,110
Fe (mg/100g)									1	0,469	0,770**
Mn (mg/100g)										1	0,676**
Zn (mg/100g)											1

** and *Correlation is significant at the 0.01 and 0.05 level.

Conclusion

Groundnuts are a rich source of protein, lipids, vitamins, and minerals, essential for human health and overall well-being. They promote growth and energy, enhance metabolic processes, and are a practical addition to the food composition table.

The research findings indicate that the groundnut cultivar BARI-11 has the maximum fat content, whereas Basunti has the highest quantity of β-Carotene.

The cultivars BARI-10, Zinga, BINA-08, BINA-04, Dhaka-01, and BINA-04 had the highest concentrations of calcium (Ca), magnesium (Mg), potassium (K), iron (Fe), manganese (Mn), and zinc (Zn) minerals, respectively.

Recommendation

Cultivar BARI-11 & Basunti can be cultivated for getting the highest amount of fat & β-Carotene. For getting the highest quantity of Ca, Mg, K, Fe, Mn & Zn it can recommend BARI-10, Zinga, BINA-08, BINA-04, Dhaka-01 & BINA-04 cultivars.

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Conflict of interest: All authors declare no conflict of interest.

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