Comparative Study on Chemical Composition of Five Varieties of Groundnut (*Arachis hypogaea*)

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**Abstract:** Experiment was conducted on five varieties growing in large scale in Bangladesh which were evolved by BARI and subjected to the comparative evaluation of its physicochemical properties. Among these varieties, the highest seed weight was found in BARI Chinabadam-7 (128.3g) and lowest seed weight was found in Dhaka-1(66.76g). The variety Dhaka-1 was contained highest amount of moisture (5.120%) while lowest amount was found BARI Chinabadam-9(1.230%). The variety BARI Chinabadam-8 contained significantly highest amount of ash (9.6%) and lowest amount of ash contained was found in BARI Chinabadam-9(7.8%). In this analysis, significantly highest amount of carbohydrate found in BARI Chinabadam-6 (38.88%) and lowest protein was found in BARI Chinabadam-9 (36.60%). The variety Dhaka-1 had the lowest amount of oil contained (49.20%) while the variety BARI Chinabadam-9 contained significantly highest amount of oil (50.76%). The amounts of total energy contained in these varieties were ranged from 290.3 Kcl/gm to 317.7 Kcl/gm. The amount of saturated fatty acids (10.92 to 17.47%) and the amount of unsaturated fatty acids (81.13-94.81%) were found to be present in each variety. Substantial genetic variability exists for chemical composition and nutritional traits which could be utilized for various food preparations and selection for breeding purpose. It also shows the utilization of groundnut and suggests the future strategy for the nutritionist, health advisors and dieticians as to how to make best use of the groundnut.

**Key words:** Ground nut • Carbohydrates • Protein • Fats • Energy • Fatty acid profile • Ash and Mineral

**INTRODUCTION**

An important segment of Bangladesh agriculture is oilseed crops. In our country about ten oilseed crops are grown. These are mustard, sesame, groundnut, linseed, niger, safe flower, soybean, sunflower and castor. Groundnut is considered as a vital source of nutrients and calories and for optimum health. Chemical composition of groundnut influence by of genotype, seed maturity, climatic conditions and growth location is considered in the present work. In addition, groundnut oils from wild species found in South America as well as from peanut lines developed through conventional breeding are also compared [1]. Proximate, physic o-chemical and elemental analysis of groundnut were determined and be considered as a good source of protein with high nutritional value [2]. Substantial genetic variability exists for chemical composition and nutritional traits which could be utilized for various food preparations and selection for breeding [3]. Proximate, mineral composition and physicochemical characteristics of two varieties of bambara groundnut (*Vigna subterranean*) flours were determined using standard techniques [4]. Ground nut often are enriched with health benefiting nutrients that are beneficial to human health. Nuts are a good source of oil containing higher unsaturated fatty acids (UFAs) to saturated fatty acids (SFAs) ratio [5]. A mineral that is primarily associated with strengthening of bones, gums and teeth and plays an important role in the normal functioning of the visual cycle, mechanism of blood coagulation [6], immune systems, wound healing [7], normal growth and development during pregnancy, childhood and adolescence [8]. A serving of one hundred grams of roasted ground nut provide 0.671 mg and thus ground nut are an excellent source of copper providing over 70% of our daily needs [9]. Another study sought to determine...
protein, oil, fatty acids, carbohydrate and total energy in the cultivars grown in the country to form the basis for further breeding activity for quality improvement and to inform users which genotypes to select for their products [10]. The chemical quality and stability of oils (iodine value and O/L ratio) from wild peanut studied in this work are not better than those of cultivated peanut [11]. The oil content of groundnut differs in quantity, the relative proportion of fatty acids, geographical location, seasons and growing conditions [12-14]. Groundnut seed contains 44 to 56% oil and 22 to 30% protein on a dry seed basis and is a rich source of minerals (phosphorus, calcium, magnesium and potassium) and vitamins (E, K and B group) [15]. Groundnut seeds are reported to contain 9.5 to 19.0% total carbohydrates as both soluble and insoluble carbohydrate [16-20]. In other studies it has been proved that the frequent nut consumption has beneficial effects on serum lipids and lipoproteins in lowering the rates of coronary artery disease [21,10]. In many African countries often deaths are reported as due to malnutrition and they could possibly be prevented by providing a protein rich diet [22]. The purpose of the present investigation was to determine nutritive value of the Arachis hypogaea species which represent natural resources with potential economic for use in human and animal nutrition.

**MATERIALS AND METHODS**

Mature pods of 5 ground nut varieties namely, Dhaka-1, BARI Chinabadam-6, BARI Chinabadam-7, BARI Chinabadam-8 and BARI Chinabadam-9 were collected from BARI Research Institute, Gazipur. The seeds and pod shells were separated manually. The mature and healthy seeds were ground and stored in glass containers for analysis.

**Total Carbohydrate Estimation:** The method was described by Raghuramulu et al. (2003) [23]. The content of the available carbohydrate was determined by the following equation:

\[
\text{Carbohydrate} = 100 - [(\text{Moisture} + \text{Fat} + \text{Protein} + \text{Ash} + \text{Oil/Fats}) \text{ g/100g}]
\]

**Estimation of Total Protein Content by Microkjeldhal Method:** Nitrogen content was determined using the Kjeldahl apparatus (KelPlus, Pelican Equipment, Chennai, India) and the amount of nitrogen was multiplied by a factor 6.25. Methods described in AOAC [24].

**Estimation of Oil by Soxhlet Apparatus:** The fat was determined by the procedure of Hughes [25] contains usual lipids including waxes pigments, certain gums and resins. Crude fat was determined using the Soxhlet extractor (Socs Plus, Pelican Equipment, Chennai, India) with ether as solvent. A better name for these constituents would be “ether soluble extract.”

**Estimation of Energy:** The gross food energy was estimated by multiplying the crude protein, crude fat and total carbohydrate by at water factors 4, 9 and 4 respectively, Okwu [26] and Osborne and Voogt [27].

**Estimation of Fatty Acids Composition by Gas Liquid Chromatography:** Seed sample of rapeseed and mustard were received from ORC, BARI, Joydebpur, Gazipur. Fatty acid composition was determined by Gas-liquid chromatographic method of Uppstrom et al. [28].

**Estimation of Iodine Value:** The iodine values (IVs) were calculated from fatty acid composition by the method of Hashim et al., [29] using the following formula:

\[
\text{IV} = (\% \text{Oleic} \times 0.8601) + (\% \text{Linoleic} \times 1.7321)
\]

**Estimation of Moisture:** Moisture content ground nut sample was determined by conventional method i.e., drying in an oven at 100° C for overnight.

**Estimation of Ash:** The ash of each sample was digested with 5mL of 2M HNO₃ and heated to dryness on a heating mantle. 5mL of 2M HNO₃ was added again, heated to boil and filtered through a Whatman No 1 filter paper into a 100ml volumetric flask. The filtrated was made up with distilled water. Methods were described by AOAC [24].

**Estimation of Mineral:** Calcium, Potassium and Sodium was determined using Jenway Digital Flame Photometer (PFP7 model) while other minerals apart from phosphorus were determined using Buck Scientific Atomic Absorption Spectrophotometer (BUCK 210VGP model). The Phosphorus in the sample filtrated was determined by using Vanadomolybdate reagent at 400nm using colorimetric method of AOAC [24].

**Statistical Analysis:** The recorded date for each character from the experiments was analyzed statistically to find out the variation resulting from experimental treatments using MSTAT package program. The mean for all the treatments were calculated and analysis of variance of characters under the study was performed by F variance test. The mean differences were evaluated by Least Significance Difference test.
Seed Weight: Weight of hundred seed of different released varieties of groundnut is presented in Table 1. It was found that seed weight varied with their size and shape. Seed weights were determined at 13% moisture level. The highest seed weight was found in BARI Chinabadam-7 (128.3g) which was followed by BARI Chinabadam-6 (116.8g) and lowest was found in Dhaka-1 (66.76g). Statistically similar results were shown by BARI Chinabadam-8 (99.08g), BARI Chinabadam-9 (100.2g). The seed weight more or less similar to the reported of Siddiqui et al. [30], Kumar and Singh [31].

Moisture: In storage condition, the permeable moisture level of different oil seeds are 10-12%. Moisture content is important factor than other nutrients as they vary with it. It is also important for insect infestation and disease. The moisture content of different released variety of ground nut was presented in Table 1. The moisture content of different released varieties were ranged from 1.230 to 5.120%. The variety Dhaka-1 contained highest amount of moisture (5.120%) and lowest amount was found in BARI Chinabadam-7 (66.76g). Statistically similar results were shown by BARI Chinabadam-8 (99.08g), BARI Chinabadam-9 (100.2g). The seed weight more or less similar to the reported of Siddiqui et al. [30], Kumar and Singh [31].

Ash: Ash content of different released varieties of Arachis hypogaea were variable and ranged from 7.8% to 9.6% (Table 5). The variety BARI Chinabadam-8 contained significantly highest amount of ash (9.6%). The lowest amount of ash content (7.8%) showed by variety BARI Chinabadam-9. The present investigation was higher than the reported value of Aremu, et al. [4], Atasie et al. [2] and Olaleye, et al. [33]. This might be due to the genetic variation among the varieties.

Proteins in Ground Nut: Protein is the major nutrient components of different varieties of ground nut. Protein content is genetically controlled. It is also influenced by nitrogen fertilizer application and agronomies practices. The protein content was determined on moisture free basis. Protein content of different variety and advanced line are presented in Table 1. Significantly highest amount of protein was obtained from BARI Chinabadam-8 (38.88%) and lowest protein content was found in BARI Chinabadam-7 (36.60%), which followed by BARI Chinabadam-7 (36.60%), which followed by BARI Chinabadam-7 (36.60%).
Table 3: Fatty acid composition and iodine value of different varieties of ground nut (*Arachis hypogaea*)

<table>
<thead>
<tr>
<th>Name of the variety (Treatments)</th>
<th>Palmitic Acid</th>
<th>Stearic Acid</th>
<th>Oleic Acid</th>
<th>Linoleic Acid</th>
<th>Linolenic Acid</th>
<th>Ecosenic Acid</th>
<th>Iodine Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka-1</td>
<td>13.02</td>
<td>3.300</td>
<td>16.32</td>
<td>42.25</td>
<td>37.24</td>
<td>1.800</td>
<td>82.39</td>
</tr>
<tr>
<td>BARI Chinabadam-6</td>
<td>8.620</td>
<td>2.300</td>
<td>10.92</td>
<td>63.26</td>
<td>28.17</td>
<td>1.330</td>
<td>94.5</td>
</tr>
<tr>
<td>BARI Chinabadam -7</td>
<td>10.35</td>
<td>2.760</td>
<td>13.11</td>
<td>62.10</td>
<td>29.94</td>
<td>0.0000</td>
<td>94.81</td>
</tr>
<tr>
<td>BARI Chinabadam -8</td>
<td>14.12</td>
<td>3.350</td>
<td>17.47</td>
<td>40.40</td>
<td>37.00</td>
<td>2.170</td>
<td>81.13</td>
</tr>
<tr>
<td>BARI Chinabadam-9</td>
<td>11.96</td>
<td>3.390</td>
<td>15.35</td>
<td>49.20</td>
<td>33.44</td>
<td>2.410</td>
<td>87.31</td>
</tr>
<tr>
<td>LSD</td>
<td>0.01883</td>
<td>0.01883</td>
<td>0.03261</td>
<td>0.01883</td>
<td>0.01883</td>
<td>0.01883</td>
<td>0.02663</td>
</tr>
<tr>
<td>CV (%)</td>
<td>0.09</td>
<td>0.36</td>
<td>0.00</td>
<td>0.02</td>
<td>0.03</td>
<td>0.65</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Figure in a column do not differ significantly at 5% level by DMRT

Chinabadam-6 (36.63%). The present values were higher with the reported values of Poulter *et al.* (1981), Onimawo *et al.*, Ferrao *et al.*, Amarteifio *et al*. and Salunkhe, *et al.* [34-38]. This might be due to the nitrogen fertilizer application, ecology and agronomics practices.

**Lipids in Ground Nut:** The oil content of the ground nut seeds depends on many factors like genetic factor; agro-ecological conditions include cultivation sites and crop management system etc. The oil was pale yellow in colour and in liquid state at room temperature. A significant variation in the crude oil content was observed among the five varieties. The oil content of different varieties of ground seeds were extracted by petroleum ether (40-60°C) varied from 290.3 to 317.7 Kcal/gm (Table 1). The variety Dhaka-1 had the lowest amount of oil contained (49.20%) and BARI Chinabadam-8 (49.20%) while the variety BARI Chinabadam-9 contained significantly highest amount of oil (50.76%). The oil content of these pea nut varieties were found to be comparable to those reported by Fasoyiro *et al.* [39] and Asibuo *et al.* [3].

**Energy from Ground in Respect of Carbohydrates, Protein and Fats:** A significant variation was found in the total energy content among the five varieties. The total energy content of different varieties of ground nut seeds were varied from 290.3 to 317.7 Kcal/gm (Table 1). The variety BARI Chinabadam-7 had the lowest amount of total energy content (290.3 Kcal/gm), followed by Dhaka-1 (291.9 Kcal/gm) and BARI Chinabadam-8 (291.9 Kcal/gm)) while the variety BARI Chinabadam-9 contained significantly highest amount of total energy content (317.7 Kcal/gm). The total energy content of these ground nut varieties were found to be comparable to those reported by Okwu, Osborne and Voogt [26-27].

**Fatty Acid Composition and Iodine Value:** The analytical data of various fatty acid content computed by GLC techniques were summarized in the Table 3. Significantly highest amount of palmitic acid was observed in BARI Chinabadam -8 (14.12%) and lowest amount of palmitic acid content was observed in BARI Chinabadam-6 (8.62%) which was significantly lowest among all the varieties. The variety BARI Chinabadam-9 (3.39%) contained highest amount of stearic acid and lowest amount was found in BARI Chinabadam-6 (2.300%) which was significantly lowest among all the varieties. Oleic acid content of the varieties ranged from 40.40 to 63.26%. Significantly highest amount was found in BARI Chinabadam-6 (63.26%) and lowest amount was found in BARI Chinabadam-8 (40.40%). The lenoleic acid content of the varieties were ranged from 28.17 to 37.24%. Highest amount of lenoleic acid contained was found in Dhaka-1 (37.24%) which was significantly highest among all the varieties and lowest amount was found in BARI Chinabadam-6 (28.17%). The linolenic acid content is important from the stand point of utilization of oil for food products. Linolenic acid, ecosenic acids were also present in these varieties. The concentration of linolenic acid varied from 2.41 to 0% where as ecosenic acid contents ranged from 1.10 to 2.77%. Iodine value of the varieties ranged from 98.83 to 105.3%. The highest amounts of saturated fatty acids were found in BARI Chinabadam-8 (17.47%) and lowest amount was found in BARI Chinabadam-6 (10.92%) while the higher amounts of unsaturated fatty acids were found in BARI Chinabadam-6 (94.81%) and lowest amount observed in BARI Chinabadam-9 (81.13%). Highest Iodine value was found in BARI Chinabadam-7 (105.3%) which was significantly highest among all the varieties and lowest Iodine value was found in BARI Chinabadam-8 (98.83%).
Table 4: Proximate analysis of major mineral content of different varieties of Ground nuts (Arachies hypoges)

<table>
<thead>
<tr>
<th>Name of varieties (Treatment)</th>
<th>Ca%</th>
<th>Mg%</th>
<th>Cu (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka-1</td>
<td>2.400</td>
<td>0.7250</td>
<td>11.88</td>
</tr>
<tr>
<td>BARI Chinabadam-6</td>
<td>2.280</td>
<td>0.7220</td>
<td>11.35</td>
</tr>
<tr>
<td>BARI Chinabadam-7</td>
<td>2.310</td>
<td>0.7320</td>
<td>11.22</td>
</tr>
<tr>
<td>BARI Chinabadam-8</td>
<td>2.300</td>
<td>0.7340</td>
<td>10.68</td>
</tr>
<tr>
<td>BARI Chinabadam-9</td>
<td>2.380</td>
<td>0.7200</td>
<td>11.28</td>
</tr>
<tr>
<td>LSD (0.01883)</td>
<td>NS</td>
<td>0.01883</td>
<td></td>
</tr>
</tbody>
</table>

CV (%) = 0.47, 0.30, 0.08

Figure in a column do not differ significantly at 5% level by DMRT.

Table 5: Proximate analysis of minor mineral content of different varieties of Ground nuts (Arachies hypoges)

<table>
<thead>
<tr>
<th>Name of varieties (Treatment)</th>
<th>Fe (ppm)</th>
<th>Zn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka-1</td>
<td>70.92</td>
<td>42.18</td>
</tr>
<tr>
<td>BARI Chinabadam-6</td>
<td>94.08</td>
<td>48.90</td>
</tr>
<tr>
<td>BARI Chinabadam-7</td>
<td>97.92</td>
<td>57.66</td>
</tr>
<tr>
<td>BARI Chinabadam-8</td>
<td>127.4</td>
<td>66.96</td>
</tr>
<tr>
<td>BARI Chinabadam-9</td>
<td>195.5</td>
<td>57.96</td>
</tr>
<tr>
<td>LSD (0.01883)</td>
<td>0.01883</td>
<td>0.01883</td>
</tr>
</tbody>
</table>

CV (%) = 0.01, 0.02

Figure in a column do not differ significantly at 5% level by DMRT.

Major Minerals in Ground Nut: Groundnut provides considerable amounts of mineral to supplement the dietary requirements of humans and farm animal. Different major and minor minerals were analyzed this work. The amounts of major minerals content of groundnut are presented in Table 3. It is well known that groundnut contained small amount of minerals.

Calcium (Ca): In case of calcium content of different released varieties were ranged from 2.28% to 2.40% (Table 3). Significantly highest amount of calcium (Ca) content was observed Dhaka-1(2.40%), followed by BARI Chinabadam-6 (2.38%), BARI Chinabadam-6 (2.31%), BARI Chinabadam-6 (2.30%) and BARI Chinabadam-6 (2.28%). These varieties are statistically similar in respect to calcium content. The present investigations were supported by reported value of FAO [6] and Atasie et al. [2].

Cupper (Cu): In case of cupper content of different released varieties were ranged from 11.88% to 10.68% (Table 3). Significantly highest amount of cupper (Cu) content was observed Dhaka-1(11.88%), followed by BARI Chinabadam-6 (11.34%) and BARI Chinabadam-6 (11.22%). These varieties are statistically similar in respect to cupper content. The lowest amount of cupper content was obtained from BARI Chinabadam-6 (10.68%). The present investigations were supported by reported value of Aremu, et.al. [4].

Minor Minerals in Groundnuts

Iron (Fe): Irons contained of different varieties were ranged from 70.92 to 195.48 (Table 4). Significantly highest amount of Fe contained was observed BARI Chinabadam-6 (195.48 ppm) which was followed by BARI Chinabadam-6 (127.44 ppm). The variety Dhaka-1 showed lowest amount of Fe (70.92 ppm) which was followed by BARI Chinabadam-6 (94.08 ppm) and BARI Chinabadam-6 (97.92 ppm). These might be influenced the different levels of Fe in soil, Fertilizer and variation among the varieties. The present values were higher than the reported values of Miret et al. [8] and Aremu, et.al. [4].

Zinc (Zn): Zinc is a cofactor for most of the dehydrogenases that require the coenzymes NAD and NADP. This mineral also supports our immune systems, helps in wound healing and is involved in building proteins. Zinc is an essential mineral for normal growth and development during pregnancy, childhood and adolescence. Zinc also helps the cells in human body
communicate by functioning as a neurotransmitter. The zinc content of different varieties were ranges from 42.18 to 66.96 ppm in (Table 3). Significantly highest amount of Zn contained was found in BARI Chinabadam-6 (66.98 ppm) which was followed by BARI Chinabadam-6 (57.96 ppm) and BARI Chinabadam-6 (57.66 ppm). The lowest amount was found in Dhaka-1 (42.18 ppm) which was followed by BARI Chinabadam-6 (48.9 ppm). These treatments are statistically similar. The present values were supported by the reported value of Institute of Medicine, Food and Nutrition Board [9].

CONCLUSION

Ground nut are an excellent and affordable source of nutrition, supplementing vital nutrients to the human body such as proteins, carbohydrates, lipids and fatty acids. Ground nut are often referred as poor man’s protein but, when taken in adequate amounts in any form, will supplement rich nutrients to the body that can provide growth and energy and play a vital role in the prevention of diseases. Poly unsaturated and monounsaturated fatty acids, whose consumption can increase the levels of HDL cholesterol which is good for the heart, are present in Ground nut. A diet including Ground nut could provide all these vital nutrients and play a critical role in preventing disease and promoting good health. It is, therefore, concluded that the present peanut varieties particularly Golden, could be the best choice for the biochemists, food scientists, researchers and manufacturers concerning food and nutrition. The present data could be a source of information for the researchers and manufacturers concerning the groundnut. The data may also be helpful for the nutritionist and nut consumers in the selection of the best foods and food products.

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REFERENCES


