Proximate Composition and the Mineral Contents of Soya Beans (*Glycine max*) Available in Kano State, Nigeria

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**ABSTRACT**

Soya bean is an 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 soya bean, the higher its quality. The mineral and proximate contents of the variety of soya beans available in Kano state, Nigeria, were determined using standard procedures. The percentage (%) proximate composition was found to be Moisture 8.13%. Crude Protein 29.24%, Crude Fibre 6.84%, Crude Lipid 30.31%, Ash 4.61%, and Carbohydrate 5.08%. While the average mineral contents (%) were found to be 0.003 (Na), 0.216 (K), 0.281 (Mg), 0.324 (Ca), 0.722 (P), 0.003 (Zn), 0.002 (Cu), 0.291 (Mn) and 0.018 (Fe). The result is an indication of the nutritional importance of soya beans, and thus its production and quality require to be improved.

**Keywords:** Mineral content, Nutritional value, Proximate composition, Soya beans

**INTRODUCTION**

High-quality protein and oil are of paramount importance to human beings. 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 (Food Labeling, 1999). 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). On another hand, soya bean products are largely known to play an important role in the health and healthy living (Messina and Barnes, 1991; Messina, 1995; Sirtori et al., 1995). Soya bean intake is reported to prevent heart disease, obesity, hypercholesterolemia, cancer, diabetes, kidney disease, and osteoporosis, and it is also suitable for people with allergic reactions caused by animal milk (Garcia et al., 1998).

*Glycine max* has the highest protein content (40%) among cereals and other legumes. Other legumes have a protein content of between 20 to 30%, while cereals have a protein content in the range of 8-15% (Salunkhe et al., 1983). Soya beans protein content (40%) is higher and more economical than that of beef (19%), chicken (20%), fish (18%) and groundnut (23%) (IITA 1990). Soya bean is also of particular interest as a vegetable protein source because of its cholesterol-lowering abilities in patients with type II hyperlipoproteinemia (Mitchel 1993). The soya bean also contains about 20% oil, the second-highest content among all food legumes, with the highest oil content found in peanut, which is about 48% on dry matter basis, while the third-highest oil content is chickpea which is about 5% (Salunkhe et al., 1983). Soya bean is also rich in minerals and vitamins such as iron, zinc, copper, thiamine, riboflavin, niacin, and pantothenic acid, as well as phospholipids (McArthur et al., 1988). Most of these vitamins and minerals are well-known hematinic and are essential in the formation of red blood cells (Singh et al., 2000). Soya bean is reported to contain flavonoids especially isoflavones, and this is the reason why they are regarded as having a powerful ability to fight and prevent cancers in humans, as well as other diseases (Messina et al., 1994).

This study was aimed at determining the mineral contents and proximate composition of soya bean grown in Kano state, North-West Nigeria.
MATERIALS AND METHODS
Sample Collection and Preparation
Mature soya bean seeds were obtained from Dawanau market in Dawakin Tofa Local Government of Kano State, Nigeria. The seeds were grounded with pestle and mortar and then packed in an airtight container and stored in a desiccator (containing silica gel) ready for further analysis.

All the chemicals used were of analytical grade.

Determination of Mineral Content
The mineral analysis was carried out using 10 g of the grounded soya bean seed and subjected to dry ashing for 5 hr in well-cleaned porcelain crucibles at 550°C. The residue ash was dissolved in 5 ml of HNO₃/HCl (1:2) and heated gently on a hot plate until the brown fumes disappeared and white coloration was formed. The solution on each crucible was filtered into 100 ml volumetric flask, and the volume made up to 100 ml with deionized water.

The cations (Na, K, Mg, Ca, P, Zn, Cu, Mn, and Fe) were determined using flame atomic absorption spectrophotometer (model VGP 210, Buck Scientific, USA) (Shahid et al., 1999).

Determination of Proximate Composition
The proximate compositions of the grounded soya bean seed were determined using standard analytical methods. All measurements were done in triplicates and values presented in percentage.

Moisture Content
Two grams of the grounded soya bean seed was oven-dried in a crucible at 105 °C overnight. The dried sample was then cooled in a desiccator for 1 hr and weighed to a constant weight, and the percentage loss in weight was expressed as percentage moisture content (AOAC, 1999).

Ash Content
Ashing was carried out using 2 g of dried milled soya bean seeds in a muffle furnace at 550 °C for 6 hr. The residual ash in the crucible was cooled in a desiccator and weighed. The percentage of residue weighed was expressed as ash content (AOAC, 1999).

Crude Lipid Content
Continuous extraction of lipid was done for 5 hr with petroleum ether in a soxhlet extractor using 2.00 g of the sample to determine the crude lipid content (Udo and Oguwele, 1986).

Crude Protein Content
Kjeldahl method was used to determine total protein. Here 1 g of the sample was placed into a filter paper and introduced into a Kjedahl flask, 10 ml of concentrated H₂SO₄ were added and digested in a fume cupboard until the solution becomes colorless. The distillation was carried out with 15 ml of 50% of NaOH. The tip of the condenser was dipped into a conical flask containing 6 ml of 4% boric acid in a mixed indicator until a green coloration was observed. Titration was done in the receiver flask with 0.01 M HCl until the solution turned red (Gabriel et al., 2018).

Crude Fibre Content
Estimation of the crude fiber was done by acid and alkaline digestion methods in which 2.00 g of each sample were used with 20% H₂SO₄ and NaOH solution (Gabriel et al., 2018).

Carbohydrate Content
The carbohydrate content of the sample was determined by estimation using the arithmetic difference method (De Conto et al., 2011; James, 1995) as defined by equation (1).

\[
\text{%Carbohydrate} = 100 \cdot (\% \text{ Moisture} + \% \text{ Fat} + \% \text{ Ash} + \% \text{ Fibre} + \% \text{ Protein})
\]

RESULTS
The sample of the ground soya bean seed was analyzed for different proximate composition including moisture content, ash content, crude lipid content, crude protein content, crude fiber content, and carbohydrate content using different standard techniques, and the results are presented in Table 1. The results for the analysis of some mineral elements, including Na, K, Mg, Ca, P, Zn, Cu, Mn, and Fe are presented in Table 2.

Table 1: Proximate Composition (%) of the Soya Bean Seed

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Component</th>
<th>Mean Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Moisture</td>
<td>8.13</td>
</tr>
<tr>
<td>2.</td>
<td>Crude Protein</td>
<td>39.24</td>
</tr>
<tr>
<td>3.</td>
<td>Crude Fibre</td>
<td>6.84</td>
</tr>
<tr>
<td>4.</td>
<td>Crude Lipid</td>
<td>30.31</td>
</tr>
<tr>
<td>5.</td>
<td>Ash</td>
<td>4.61</td>
</tr>
<tr>
<td>6.</td>
<td>Carbohydrate</td>
<td>5.08</td>
</tr>
</tbody>
</table>

Table 2: Mineral Content (%) of the Soya Bean Seed

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Na</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>P</th>
<th>Zn</th>
<th>Cu</th>
<th>Mn</th>
<th>Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>0.003</td>
<td>0.216</td>
<td>0.281</td>
<td>0.324</td>
<td>0.722</td>
<td>0.003</td>
<td>0.002</td>
<td>0.291</td>
<td>0.018</td>
</tr>
</tbody>
</table>
DISCUSSION

From Table 1, the moisture content was found to be 8.13% agreed with similar finding of 8.07% reported by Ogbenudia et al., (2017). This low moisture content of soya bean is of advantage because it enables the seed to be stored for a very long time. A protein content of 39.24% was obtained in this research, and as contained in the McGraw-Hill Encyclopedia of Science and Technology (2002) soya beans contain about 40% protein. Our result tallies with the findings reported by Ogbenudia et al., (2017) who reported similar values of 37.69%. This large amount of protein in soya beans along with the high biological value increases their value as feedstuff and is also one reason for the economic advantage that soya bean have over other oil seeds (Synder and Kwon 1987). Moreso, the incorporation of soya beans food into a diet could be an important means of preventing and treating some chronic diseases such as cancer and cardiovascular diseases (Prestamo et al., 2002), and it could be used in the management of protein deficiency cases such as Kwashiorkor and marasmus (Ogbemudia et al., 2017). The fibre content of the soya bean sample was found to be 6.83%, and this is in line with the reported results by Cole et al., 1999 who revealed a percentage fibre content of 6.5%. Although that may be low, the presence of fiber in foods is known to be beneficial. Fibre has some physiological effects in the gastrointestinal, tract. These effects include variation in fecal water, fecal bulk and transit time and elimination of bile acids and neutral steroids which lower the body cholesterol pool and can also cut the risk of colon cancer (Ogbemudia et al., 2017). The high crude fat content of 30.31% in this study is an indication that soya bean may be an excellent source of oil, and this report falls with the values (18.8 – 40.1%) obtained and reported by Ensminger et al.,1990; Banaszkiewicz, 2000; Ogbenudia et al., 2017. The observed results support the usefulness of soya bean seed like a good source of edible oils which can be used in cooking as well as soap manufacturing industry (Ogbemudia et al., 2017). According to report by Lokuruka (2010) soya beans have an ash content of about 5%, and this supports the finding of this research (4.61%), with Ogbenudia et al., (2017) reporting an ash content of 4.29%. The major minerals in soya beans are potassium, phosphorus, magnesium, calcium, and manganese (O’Dell 1979; Van Eys et al., 2004). Since it is generally established that mineral bioavailability from consumption of animal foods is better than from plant foods (Cook et al., 1981) then the use of plant sources like soya beans if paramount importance.

Generally, the results obtained in this study suggest that soya bean can be a good source of protein, fat/oil, carbohydrate, minerals, and crude fiber and therefore should be exploited as commercial source to supplement both animal and human consumption. The oil could be a good material for soap making.

CONCLUSION

The results from this work showed that the variety of soya beans grown in Kano state, Nigeria, contains high protein and lipid contents making them good sources of these food substances. Their fiber content is low but still can be useful in correcting some body problems like diabetes and obesity. High ash content was observed in soya beans, and this indicate that they are important sources of minerals like sodium, potassium, magnesium, calcium, phosphorous, zinc, copper, manganese and iron.

REFERENCE


