***ChemSearch Journal 10(2): 62 – 65, December, 2019***
Publication of Chemical Society of Nigeria, Kano Chapter

Received:13/09/2019 Accepted:15/10/2019
http://www.ajol.info/index.php/csj

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

**[1]Bayero A. S., [*1]Datti Y., [1]Abdulhadi M., [1]Yahya A. T., [1]Salihu I., [1]Lado U. A., [2]Nura T. and [3]Imrana B.**

[1]Department of Chemistry, Yusuf Maitama Sule University, Kano.
[2]Department of Chemistry, School of Science Education, FCE (T) Bichi.
[3]Department of Chemistry, Shehu Shagari College of Education Sokoto.
***Correspondence Email:** yaudatti@gmail.com

## 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 it's 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 39.24%, 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). Soy bean is also of particular interest as a vegetable protein source because of its cholesterol-lowering abilities in patients with type II hyperlipoproteinamia (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 $HNO_3$/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 $H_2SO_4$ 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% $H_2SO_4$ 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).

$$\%\text{Carbohydrate} = 100 - (\%\ \text{Moisture} + \%\ \text{Fat} + \%\ \text{Ash} + \%\ \text{Fibre} + \%\ \text{Protein}) \quad (1)$$

## 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**

| S/NO | Component | Mean Value (%) |
|---|---|---|
| 1. | Moisture | 8.13 |
| 2. | Crude Protein | 39.24 |
| 3. | Crude Fibre | 6.84 |
| 4. | Crude Lipid | 30.31 |
| 5. | Ash | 4.61 |
| 6. | Carbohydrate | 5.08 |

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

| Mineral | Na | K | Mg | Ca | P | Zn | Cu | Mn | Fe |
|---|---|---|---|---|---|---|---|---|---|
| **Concentration** | 0.003 | 0.216 | 0.281 | 0.324 | 0.722 | 0.003 | 0.002 | 0.291 | 0.018 |

**DISCUSSION**

From Table 1, the moisture content was found to be 8.13% agreed with similar finding of 8.07% reported by Ogbemudia *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 Ogbemudia *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 fiber 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; Ogbemudia *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 Ogbemudia *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**

AOAC (Association of Official Analytical Chemists), (1999). Official Methods of Analysis AOAC International Methods 934.01, 988.05, 920.39, and 942.05. Arlington, VA. USA: AOAC International.

Banaszkiewicz, T. (2000). Nutritive Value of New Rape Cultivars Stated in the Tests for Broiler Chickens (in Polish). *Thesis University of Podlasie*, 61:1-99.

Cole, J.T., Fahey, G.C., Merchen, R., Patil, A.R., Murray, S.M., Hussein, H.S., and Brent, J.L. (1999). Soybean Hulls as a Dietary Fiber Source for Dogs. *Journal of Animal Science*, 77:917-924.

Cook JD., Morck TA., and Lynch SR. (1981) The Inhibitory Effect of Soy Products on Nonheme Iron Absorption in Man. *Am. J. Clin. Nutr.* 34:2622.

De Conto LC., Gragnani MAL., Maus D., Ambiel HCI., Chiu MC., Grimaldi R. and Goncalves LAG. (2011). Characterization of Crude 62 Watermelon Seed Oil by Two Different Extraction Methods. *Journal of American Oil Chemists' Society* 88:1709 - 1714.

Ensminger, M.E., Oldfield J.E., and Heinemann W.W. (1990). Feeds and Nutrition. The Ensminger Publishing Company, ISBN 0941 21 80 82, Clovis, California, pp120 – 165.

Food Labeling (1999) Health Claim Soy Protein and Coronary Heart Disease. Final Rule. Pp3 – 14.

Gabriel AF., Igwemmar N C., Sadam AA. and Babalola SA. (2018) Characterization of Seed Oil from *Citrullus lanatus* (Watermelon) *Direct Res. J. Public Health and Environ. Technol.* 3(2):34-40.

Garcia, M. C., Torre, M., Laborda, F. and Marina, M. L. (1997) Rapid Separation of Soybean Globulins by Reversedphase High-Performance Liquid Chromatography. *Chromatog. A* 758:75-83.

Garcia MC., Marina ML., Labordab F. and Torre M. (1998). Chemical Characterization of

Products Commercial Soybean *Food Chemistry*. 62:(3)325-331.

Grieshop, C.M. and Fahey, G.C., Jr. (2001) Comparison of Quality Characteristics of Soybeans from Brazil, China, and the United States. *Journal of Agriculture and Food Chemistry*, 49:2669-2673.

Henley, E. C., Steinke, F. H., and Waggle, D. H. (1993) Nutritional Value of Soy Protein Products. In Proc. World Cant Oilseed Technol. Util. 1992, ed. T. H. Applewhite, pp. 248-256.

International Institute of Tropical Agriculture (IITA) (1990). Soya Bean for Good Health: How to Grow and Use Soybeans in Nigeria. IITA Publications. 23.

Kuo TM., Eskins K. and Cooper RL. (1996) Proximate Composition of Mature Seeds from Soybean Plants Grown in Different Environments, *Seed Production, and Management: Temperature* Pp. 25-53

Lokuruka MNI (2010) Soybean Nutritional Properties: The Good and the Bad About Soy Foods Consumption-A Review *African Journal of Food Agriculture Nutrition and Development* 10(4):2439-2459

McArthur KE, Walsh JH., and Richardson CT. (1988) Soy Protein Meal Stimulates Less Gastric Acid Secretion and Gastric Release than Beef Meal Scan. *J. Gastroint.* 95:920-926.

Messina, M. and Barnes, S. (1991) The Role of Soy Products in Reducing Risk of Cancer. *J. Natl. Cancer Inst.* 83:541-546.

Messina, M., Messina, V., and Setchell, K.D.R., (1994). *The Simple Soybean and Your Health*. Avery Publishing Group, Garden City Park, New York. P57.

Messina, M. (1995) Modern Uses for an Ancient Bean: Soy Foods and Disease. Chem. Znd. 11,412-415. Metodos Ojiciales de Anrilisis. Volume I and IV (1993) Direccion General de Politica Alimentaria. Ministerio de Agricultura, Pesca y Alimentacibn, Spain. Pp412 – 415.

Mitchel HS. (1993) Protein limitation and Human Growth. *Journal of American Diet.* 44:165-171.

O'Dell BL. (1979) Effect of Soy Protein on Trace mineral Availability. In: Wilcke HL, Hopkins DR and DH Waggle (Eds.). Academic Press, New York, pp187 – 207.

Ogbemudia RE., Nnadozie BC. and Anuge B. (2017) Mineral and Proximate Composition of Soya Bean *Asian Journal of Physical and Chemical Sciences* 4(3):1-6

Openshaw, S.J., and Hadley, H.H. (1978). Maternal Effects on Sugar Content in Soybean Seeds. *Crop Science* 18:581-584

Prestamo, G., Lasuncion, M.A. and Anroyo, G. (2002) Response of Rats to the Intake of Tofu Treated Under High Pressure. *Innovative food science and emerging technologies* (3):149-155.

Salunkhe, D.K., Sathe, S.K., and Reddy, N.R. 1983. Legume lipids. In *Chemistry and Biochemistry of Legumes*, S.K. Arora (Ed.) Edward Arnold Pub. Ltd., London. Pp5 – 20.

Shahid I, Chauhdry AV. and Anjum MA. (1999). Effect of Root Stock on Leaf Mineral Composition and Productivity of Kinnow Mandarin. *Int. J. Agric. Biol*. 1:91-93.

Singh AS., Jain VK., Singh P., and Pathak NN. (2000) Effect of Feeding Wheat Bran and Deoiled Rice Bran on Feed Intake and Nutrient Utilisation in Crossbred Cows. *Indian Journal of Animal Science.* 70(12):1258-1260

Sirtori, C. R., Lovati, M. R., Manzoni, C., Monetti, M., Pazzucconi, F. and Gatti, E. (1995) Soy and Cholesterol Reduction: Clinical Experience. *J. Nutr.* 125:5988- 605s. Soy Protein Council (1987) Soy Protein Products. Characteristics, nutritional aspects, and utilization. Soy Protein Council, Washington. Pp1 – 51.

Steinke, F. H. (1992) Nutritional Value of Soyabean Protein Foods. In New Protein Foods in Human Health: Nutrition, Prevention, and Therapy, ed. D. H. Waggle, F. H. Steinke and M. N. Volgarev, CRC Press, Boca Raton, Florida, pp. 59-66.

Synder HE and Kwon TW (1987) Soybean Utilization. Van Nostrand Reinhold Co., New York, pp400 – 408.

Van Eys, J.E., Offner, A., and Bach, A. (2004). Chemical Analysis. Manual of Quality Analysis for Soybean Products in the Feed Industry. *American Soybean Association.* Pp5 – 20.

Udo EJ. and Oguwele JA. (1986). Laboratory Manual for the Analysis of Soil, Plants, and Water Samples. 3rd Edition, Department of Crop Production, University of Ilorin, Kwara State Nigeria Pp:131-152.