Plant
2019; 7(4): 62-65
http://www.sciencepublishinggroup.com/j/plant
doi: 10.11648/j.plant.20190704.11
ISSN: 2331-0669 (Print); ISSN: 2331-0677 (Online)

Nutritional Analysis of *Hibiscus sabdariffa* L. (Roselle) Leaves and Calyces

Muhammad Auwal Balarabe

Department of Pure and Applied Chemistry, Usmanu Danfodiyo University, Sokoto, Nigeria

Email address:
auwal4real72@gmail.com

To cite this article:
Muhammad Auwal Balarabe. Nutritional Analysis of *Hibiscus sabdariffa* L. (Roselle) Leaves and Calyces. *Plant.* Vol. 7, No. 4, 2019, pp. 62-65. doi: 10.11648/j.plant.20190704.11

Received: July 24, 2019; **Accepted**: August 29, 2019; **Published**: September 16, 2019

Abstract: *Hibiscus sabdariffa* commonly known as "roselle" is a member of malvaceae family. It is a plant with a worldwide fame and has more than three hundred species which are distributed in tropical and subtropical regions around the world. Many parts of Roselle including seeds, leaves, fruits and roots are used in various foods as well as in herbal medicine. This research work analyzes the nutritional composition of dried *Hibiscus sabdariffa* leaves and calyces. The moisture content was determined by exposing the sample to heat under controlled conditions, the water from the material evaporated leaving the dry matter. The ash content was determined by burning off the organic matter leaving behind inorganic ash. Base on the principle that non-polar components of samples are easily extracted into organic solvent, crude lipid was determined using n-Hexane. The protein content was obtained by Kjeldahl method. Mineral analysis was also carried out to determine the amount of Potassium, calcium and phosphorus. The result shows that the dried leaves and calyces of *Hibiscus sabdariffa* contain: Moisture: 12.50% and 10.50%, Ash: 14.50% and 11.67%, fibre: 0.83% and 1.17%, Crude lipid: 4.33% and 1.00%, Crude protein: 5.37% and 4.10% respectively. The mineral content of the leaves and calyces were; Calcium: 1.40% and 1.20%, Magnesium (mg/g): 1.35% and 1.57%, Phosphorus: 5.00% and 5.485% respectively. The leaves, of the plant can be used as vegetable to make soup and other dishes, Drinks made from Roselle calyces should be consumed regularly as it is safe, natural and nutritious.

Keywords: Roselle, Nutritional, Leaves, Calyces

1. Introduction

The goal of every community, individual, family, or a nation is to be able to consume an enjoyable, affordable and culturally acceptable diet. This act of consumption is term nutrition. Nutrition is defined as the science food, nutrients and other substances, their action, interaction, and balance in relation to the health and disease. [1] Nutrients are molecules in food that all organism need to make energy, growth, develop and reproduce. Nutrients are digested and then broken down into basic parts to be used by organism. We humans get our nutrients from what we eat, plants get their own from soil. [2]

Fruits and vegetables are consumed all over the world and play important role in human nutrition. Therefore it is necessary to investigate their nutritional values and also to find out which parts concentrate more of nutrient.

Hibiscus sabdariffa or more commonly known as Roselle in English is a shrub plant that is grown in tropical countries. It belongs to the family *Malvaceae,* [3, 4] of the *Hibiscus* genus. It can be planted in a wide range of soil conditions. For domestic cultivation, a relatively infertile soil is sufficient for it to grow. However, for commercial cultivation, the soil needs to be rich in organic materials and nutrients. The plant is an annual or perennial herb or woody-based sub-shrub, growing up to 2-2.5m tall. [5] The leaves are deeply 3-5 lobed, 8-15cm long arranged alternatively on the stems. [6] The flowers are 8-10cm in diameter, white to pale yellow with a dark red spot at the base of each petal and have a stout fleshy calyx at the base 1-2cm wide, enlarging to 3-3.5cm, fleshy and bright red as the fruit matures. The plant is about 3.5m tall and has a deep penetrating taproot system. [7] It takes about 6 months to mature. [8] The calyx is the most important part of the plant which contains the valuable components which determine the quality of the product namely: colour (anthocyanin), flavour (organic acid) and

aroma. The Roselle calyx is also rich in malic acid, anthocyanins, ascorbic acid and minerals. [9] The dried calyces commonly used in the preparation of cold and hot beverages and as a food colorant. [10] In Nigeria the common popular drink of Roselle is known as "zobo" and the herb is used in folk medicine in the treatment of hypertension. [11] The plant is economically important for proper metabolic process to be adequately maintained. It was discovered that the dietary constituents contributing to the protective effects of these plant materials are plant secondary metabolites in the form of phytochemicals, vitamins and minerals. [12]

The aim of this research is to study the nutritional composition of leaves and calyces of *Hibiscus sabdariffa* by determining the moisture content, ash content, crude lipid, crude fibre, protein, carbohydrate and elemental composition (calcium, magnesium, sodium, potassium and phosphorus).

2. Materials and Methods

2.1. Plant Material

Dried leaves and calyces of Roselle were bought from Sokoto Central Market in Sokoto state, Nigeria and were identified by the Botany unit (Herbarium), Department of Biological Science, Faculty of Science, Usmanu Danfodiyo University, Sokoto by Mal. Abdul-Azeez Salihu, Herbarium Officer with the batch number (UDUH/ANS/0186).

2.2. Sample Preparation

The dried leaves and calyces were grounded in a clean and dry mortar and pestle separately into fine powder, the medium was washed after pounding each sample. The ground samples were stored in polyethene bags (labeled A & B) at room temperature in a dark cupboard before analysis.

2.3. Methods

The methods used in this work were described and recommended by the Association of official Analytical Chemists. Official Method of Analysis of the Association of Official's Analytical Chemist, 7th edition Arlington, Virginia. [13]

2.3.1. Moisture Content

The samples (2g each) were weighed into each of the crucibles and the crucibles were then inserted into an oven at 105°C and allowed overnight. The crucibles were removed and inserted into a desiccator to cool for 5mins. Each sample was carefully removed from the desiccator and weighed.

The %moisture content was calculated using;

$$\%moisture = \frac{lossinweightduetodrying}{weightofsampletaken} \times 100$$

2.3.2. Ash Content

The samples (2g each) were placed in empty crucibles and weighed. The crucible containing the sample was then heated in muffle furnace at 600°C for 5 hours to burn off all the organic matter. After the ashing period, the samples were placed into a desiccator gently to cool and weighed. The ash content was calculated using the following

$$\%Ash = \frac{weightofash}{weightofsample} \times 100$$

2.3.3. Crude Lipid

The samples (2g each) were measured into glass bottle. 20cm^3 of n-Hexane was added. It was shaken thoroughly and the solvent solutions are allowed to settle for 24hrs. Empty petri-dishes were weighed. The oil was then carefully extracted into petri-dish and the solvent was allowed to evaporate and then weighed.

The percentage of crude lipid was calculated using the formula:

$$\%\ \text{Crude Lipid} = \frac{\text{weight of oil}}{\text{weight of sample}} \times 100$$

2.3.4. Crude Fibre

The samples (2g each) were placed in a conical flask, 20cm^3 of distilled water and 20cm^3 of 10% H_2SO_4 was added, it was fixed to boil for 30 minutes to maintain constant volume. The samples were filtered and rinsed with water. The samples were scrapped into a flask with the aid of spatula. 20cm^3 of 10% NaOH was added and then placed on a heater again to boil for 30mins. The samples were filtered using a filter paper and ethanol was used to rinse the samples once again, it was allowed to drain and the residue was scrapped into crucibles. The crucibles were then placed in an oven to dry at 105°C after which the weight was taken. The crucibles were then placed in muffle furnace to ash for 2 hours at 550°C and allowed to cool in desiccators and weighed again.

Percentage fibre was then calculated using the following

$$\%Crudefibre = \frac{weightafterdrying - weightafterashing}{weightofsample} \times 100$$

2.3.5. Protein

The samples (0.5g) were weighed into 2 different distillation tubes and 10cm^3 of Conc. H_2SO_4 was added into each tube followed by 40cm^3 of distilled water to dilute the acid then kjeldahl tablet was added to each tube of the mixture to digest the inorganic matter present. The tubes were sent into the digestion chamber for digestion.

From the digestion tubes, 10cm^3 of the samples were measured respectively and added into the digestion flask followed by 20cm^3 distilled water and then 20cm^3 NaOH (40%) to make up the solution. The mixture was sent into the distillation chamber for the nitrogen content; to extract out ammonia present in the sample which will be evaporated into the boric acid indicator, before protein analysis. It was allowed for about 3 minutes, where 20cm^3 of the boric acid indicator was placed into a flask and inserted beneath the distillation chamber used as the receiver of the nitrogen extracted. Where the ammonia was

liberated into the boric acid and changes the indicator's colour from pink to green.

The green mixture with ammonia was titrated against 0.01M H_2SO_4 to end point, which give the actual amount of protein content in sample. The colour change was from green to pink and the end point and the titre values were recorded respectively.

The crude protein was calculated using the following equations

$$\% \text{ Nitrogen} = \frac{\text{Tv} \times \text{N} \times 0.014 \times \text{Dilution factor} \times 100}{\text{weight of sample (w)} \times \text{vol of aliqout}}$$

% Protein = %Nitrogen × conversion factor (6.25)

2.3.6. Mineral Analysis

2g of the two samples were weighed into the crucible, and then later taken into muffle furnace for ashing. The ash sample was digested with 5cm^3 of 20% HCl and distilled water was added to make it 50cm^3.

Calcium: A pipette was used to measure 1cm^3 of the sample and was diluted with 19cm^3 distilled water. 1 cm^3 of NaOH was added with murexide indicator to a diluted sample solution. The colour of the solution at the initial stage was pink. The solution was then titrated with 0.01M EDTA solution until the colour changed to purple. The calcium content was determined using the formula

$$\% \text{ Calcium} = \frac{\text{TV X M.EDTA}}{\text{Aliquot of sample}} \times 1000$$

Magnesium: From the digested sample, 1cm^3 was pipette and diluted with 19cm^3 of distilled water, 5cm^3 of ammonium buffer solution and Erichrome black T indicator was added. The initial colour of the solution was pink. The solution was then titrated with 0.01M EDTA solution until it changes to blue colour at the end point. The magnesium content was determined using the formula

$$\% \text{ Magnesium} = \frac{\text{TV X M.EDTA}}{\text{Aliquot of sample}} \times 1000$$

Phosphorus: Using a pipette, 2cm^3 of the aliquot samples were measured into 50cm^3 volumetric flask. Phosphorus extraction solution (2cm^3) and Ammonium molybdate solution (2cm^3) were added to ¾ of the flask. Diluted stannous chloride (1cm^3) was added. The mixture was then shaken thoroughly and distilled water was added to the marked of volumetric flask (50cm^3). The colour intensity of the samples was measured using a spectrophotometer. The absorbance readings were recorded, and the phosphorus content was determined using all the dilution factors. Phosphorus content can be determined using the formula below.

$$\text{P} = \frac{\text{A X C.F X DFo X DFi}}{\text{Atomic weight of phosphurus}}$$

3. Results

The results of the nutritional composition of *Hibiscus sabdariffa* leaves and calyces are given in the tables below.

Table 1. *Proximate composition of dried Hibiscus sabdariffa leaves and calyces.*

Nutrients	Leaves	Calyces
Moisture (%)	12.50	10.50
Ash (%)	14.50	11.67
Crude Lipid (%)	4.33	1.00
Crude Fibre (%)	0.87	1.17
Protein (%)	5.37	4.10

Table 2. *Mineral composition of dried Hibiscus sabdariffa leaves and calyces.*

Minerals	Leaves	Calyces
Ca (%)	1.40	1.20
Mg (%)	1.35	1.57
P (%)	5.00	5.48

4. Discussions

The results of the nutritional composition of *Hibiscus sabdariffa* leaves and calyces given in the table 1 showed that the moisture content of the leaves is 12.50% while that of the calyces is 10.50%. The ash content revealed that the leaves have slightly higher ash (14.50%) than the calyces (11.67%). Higher ash content indicates the mineral content of substances. The variation in the ash content might be attributed to the type of vegetables used, soil variation and maturity level of vegetables. Crude lipid of the leaves (4.33%) is higher than the percentage crude lipid of the calyces (1.00%). From the analysis, the fibre content of the leaves was found to be 0.83% and that of calyces was 1.17%. Fibre is very important in diet, because it decreases serum cholesterol levels, risks of coronary heart diseases and hypertension. The crude protein found in this research were 5.37% for the leaves and 4.10% obtained from the calyces. Crude protein is a nutrient that the body needs. It also helps in the growth of the body and body maintenance.

Table 2 shows the mineral composition of dried roselle leaves and calyces. It shows the presences of sodium, potassium, calcium, magnesium and phosphorus.

Phosphorus was the most abundant mineral (5.00% and 5.48% for the leaves and calyces respectively).

Phosphorus is essential for the development of teeth most especially in young children, it plays essential role for the formation and utilization of high-energy phosphate compounds (phosphagens). Phosphate is required for the formation of phospholipids, phosphoproteins and nucleic acids (DNA and RNA). [14]

Calcium is a coordinator among inorganic elements, for example excess amount of Potassium, Magnesium or Sodium in the body can be corrected by Calcium and also adequate quantity of Calcium in the diet assist in Iron utilization. [15]

Magnesium is an activator of many enzymes systems maintains the electrical potential in nerves. The mineral content of plants can be significantly influenced by variety, location, and environmental conditions [15].

5. Conclusions

Hibiscus sabdariffa or "Roselle" is medicinal plant with a worldwide fame, having various important nutrients. From the results of this study it can be concluded that the leaves and calyces of *Hibiscus sabdariffa* contains significant amounts of nutritionally important constituents which includes moisture, crude fibre, crude lipid, protein as well as mineral elements that are essential to the growth and development of the body. The calyces have higher crude fibre, and mineral contents than the leaves, while the leaves have higher moisture, ash and protein content. The leaves, of the plant can be used as vegetable to make soup and other dishes. However care should be taken when processing the leaves to avoid loss of nutrients through excessive washing and over cooking. Drinks made from Roselle calyces should be consumed regularly as it is safe, natural and nutritious.

References

[1] Hargaty, V. (1986) Discussion in Nutrition, St. Lion publishers, Canada Pp 13-14.

[2] Davidson, S. and Passmore, R. (1996): Human Nutrition and Dietries 3rd edition; williansand Wilkins press, London, pp 50-57.

[3] Osman, M., Golam, F., Saberi, S., Majid, N. A., Nagoor, N. H. and Zulqarnain M. (2011). Morpho-agronomic Analysis of Three Roselle (*Hibiscus sabdariffa* L.) Mutants in Tropical Malaysia, AJCS 5 (10): 1150-1156.

[4] Singh, P., Khan, M. and Hailemariam, H. Nutritional and Health Importance of *Hibiscus sabdariffa*: a review and indication for research needs. *J Nutr Health Food Eng.* 2017; 6 (5): 125−128. DOI: 10.15406/jnhfe.2017.06.00212.

[5] Puro K., Sunjukta R., Samir S., Ghatak S., Shakuntala I. and Sen A., (2016) Medicinal Uses of Roselle Plant (*Hibiscus sabdariffa* L.): A Mini Review. *Indian Journal of Hill Farming 27 (1): 81-90.*

[6] Adegunloye, B. J., Omoniyi, J. O. and Ajabonna, O. P. (1996). Mechanism of Blood Pressure Lowering Effects of the Calyx Extract of Hibiscus Sabdariffa in Rats. *Journal of science*, 235-238. ethnopharmacology, volume 109, issue 3, pp. 388-393.

[7] Daudu, O. A. Y., Falusi, O. A., Dangana, M. C., Abubakar, A., Yahaya, S. A. and Abejide, D. R. Collection and Evalutation of Roselle (*Hibiscus sabdariffa* L.) germplasm in Nigeria, *African Journal of Food Science* 2015 vol. 9 (3) pp. 92-96. Doi. 10.5897/AJFS2014.1225. ISSN 1996-0794.

[8] Brunold, C., Deters A., Knoepfel-sidler, F., Hafner, J. M. and Hensel, A., (2004), Poly-Saccharides from *Hibiscus sabdariffa* Flowers Stimulate Proliferation of Human Keratinocytes Plants. *Medical plants*; 70 (4): 370-373.

[9] Javadzadeh, S. M. and Saljooghianpour, M. Morpho-agronomic characteristics of two Roselle varieties (*Hibiscus sabdariffa* L.) in tropical Iranshahr, *International Journal of Advanced Research in Biological Sciences* Volume 4, Issue 6 – 2017 DOI: 10.22192/ijarbs ISSN: 2348-8069.

[10] Maganha, E. G., Halmenschlager, R. D. C., Rosa, R. M., Henriques, J. A. P., Ramos, A. L. L. P. and Saffi, J. (2010) Pharmacologicla evidence for the extracts and secondary metabolites from plants of the genus Hibiscus Food Chem 118: 1-10.

[11] Olaleye, M. T. and Akindahunsi, A. A. (2005). Hypotensive Activity of Methanolic Extract of the Calyces of *Hibiscus sabdariffa* L on Normotensive rats. In recent progress in medicinal plants series. Plant Bioactives in Traditional Medicine. Stadium press LLC. U.S.A. 12 (9): 283-288.

[12] Okereke C. N., Iroka F. C., and Chukwuma M. O. Phytochemical Analysis and Medicinal uses of *Hibiscus sabdariffa. International Journal of Herbal Medicine* 2015; 2 (6): 16-19 E- ISSN: 2321-2187 P- ISSN: 2394-0514.

[13] AOAC (2007). Official Method of Analysis of the Association of Official's Analytical Chemist, 7th edition. Arlington, Virginia.

[14] Gatti, M., Tokalty, I. and Rubio, A. (2010). Sodium A Charge Transfer Insulator At High Pressures. Physical review letter. 104. 21: Pp 404-414.

[15] Azza, A. A., Ferial, M. A. and Esmat, A. A. (2011) Physico-chemical Properties Of Natural Pigments (Anthocyanin) Extracted From Roselle Calyces *(Hibiscus sabdariffa)*, *Journal of American Science* 7 (7) Pp 445-456.