Nutritional Analysis of Jamaica’s *Hibiscus sabdariffa* (Sorrel Calyxes, Seeds, And Leaves)

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Abstract: *Hibiscus sabdariffa* has been reported to have nutraceutical properties. Work done locally on different varieties was reported on main consumable portion, the calyxes. This research sought to include seeds and leaves. This research also sought to report on nutritional content found in the local traditional red variety, not reported prior. Extracts from sorrel’s calyxes, seeds, and leaves were analyzed for presence of carbohydrate, protein, lipid, iron, sodium, potassium, calcium, magnesium, and copper. Carbohydrate was higher in leaves and calyxes while protein and lipid were higher in seeds. Seeds had higher concentrations of copper along with lowest concentration of sodium and calcium; leaves had higher concentrations of magnesium, and iron; whilst calyxes had a higher concentration of potassium. While calyxes are main consumable portions locally, data suggested that leaves and seeds were sources of good nutrition. The presence of relatively high protein, carbohydrate, and lipid contents are indicative of possible anti-oxidative and anti-inflammatory properties. The heavy metals present could enhance human health. This study shows the Jamaican traditional red variety of *Hibiscus sabdariffa* calyxes, seeds, and leaves to have potential health benefits that can help in the prevention of diseases and contribute to good nutrition.

Keywords: Sorrel, Nutraceutical, Protein, Carbohydrate, Lipid, Heavy Metals.

1. INTRODUCTION

*Hibiscus sabdariffa*, also known as Rosella or Jamaica sorrel among many other names, is a native of India and Malaysia¹. Much work has been reported on its effectiveness against life threatening diseases in other parts of the world, treating many cardiovascular disorders, helminthic disease and cancer²; rendering this popular shrub a nutraceutical, “a food or part of a food that provides medical or health benefits, including disease treatment and prevention. Nutraceuticals range from specific nutrients, to dietary supplements, herbal products and processed foods including beta-carotene, fish oil, garlic, green tea, oat bran, olive oil and various herbs. Sometimes called functional foods³”.

While *Hibiscus sabdariffa* is from one family ‘Malvaceae’, the differences in climatic condition and soil types may attest to possible differences in chemical composition and nutritional content with local varieties compared to other regions of the world. Consequently, while much work has been done on sorrel in other parts of the world, work on the local varieties while further strengthening the collective classification of this plant as a nutraceutical such as “to support the ethnomedicinal use of *H. sabdariffa* in Africa and the Caribbean for the treatment of cardiovascular disease and hypertension⁴”, work on its nutritional composition locally has been limited with focus on main consumable portion, the calyxes.

While this research will focus on the traditional red sorrel variety⁵ grown locally, it will explore its carbohydrate, protein, lipid, iron, sodium, potassium, calcium, magnesium, and copper contents, all reported to play a role in good nutrition, with benefits ranging from healthy pregnancy, increased energy, and better athletic performance with iron consumption, to regulation of blood pressure and blood volume with sodium consumption⁶-¹⁴. Research will also look at leaves and seeds of this variety.
2. MATERIALS AND METHODS

Sorrel plants were grown in the parish of Manchester, Jamaica. Sorrel samples were prepared from modified methods at Northern Caribbean University. Analysis for carbohydrates, protein, and lipids were done at Northern Caribbean University. Nitric acid digestion of samples was also done at Northern Caribbean University before analysis at Jamaica Bureau of Standards for iron, sodium, potassium, calcium, magnesium, and copper. Analysis were done in year 2011.

3. RESULTS AND DISCUSSION

Carbohydrate was higher in leaves and calyxes while protein and lipid were higher in seeds (table 1, 2 -3). Seeds had higher concentrations of copper along with lowest concentration of sodium and calcium; leaves had higher concentrations of magnesium, and iron; while calyxes had a higher concentration of potassium (tables 4, 5).

The concentrations of carbohydrate present in sorrel calyxes, seeds, and leaves, were estimated based on their respective absorbance. Once the concentrations were determined, the provided formula (Mg of glucose/volume of test sample×100) was used in calculating the carbohydrate content of each sample.

Hibiscus sabdariffa (Jamaican sorrel), has nutritional and medicinal benefits to enhance human health and possibly preventing the occurrence and proliferation of certain human plagues like cancers. Nutritionally, the carbohydrate content in seeds were higher compared to leaves and calyxes; whilst protein analysis showed a higher content in seeds compared to calyxes and leaves. A similar pattern for lipids was observed in the calyxes, seeds, and leaves. The leaves had the least nutritional content. Chemically, calyxes and leaves had identical concentrations of sodium and calcium, while seeds had lower amounts. Calyxes had higher potassium concentration compared to seeds and leaves. Leaves had higher magnesium concentration compared to calyxes and seeds. Additionally, leaves had higher iron concentration compared to seeds, and calyxes. Seeds had higher copper concentrations compared to calyxes and leaves. All these minerals have been documented to enhance human health and to maintain the body’s metabolism. This study shows that sorrel calyxes, seeds, and leaves have potential health benefits that may help in the prevention and treatment of diseases.

REFERENCES


APPENDICES - A

List of Table

Table 1: Average of triplicated results of samples absorbance for carbohydrate analysis

<table>
<thead>
<tr>
<th>Carbohydrate analysis of Hibiscus sabdariffa calyxes, seeds, and leaves</th>
<th>Average Volume (ml)</th>
<th>Average Mass Weight (mg)</th>
<th>Average Absorbance (nm)</th>
<th>Concentration (Mg of glucose/volume of test sample×100)</th>
<th>Concentration relative to average mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyx</td>
<td>1.0</td>
<td>109.80</td>
<td>1.455</td>
<td>66.23</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>109.80±0.1</td>
<td>1.455±0.038</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>1.0</td>
<td>109.83</td>
<td>0.917</td>
<td>105.26</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>109.83±0.1</td>
<td>0.917±0.033</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaves</td>
<td>1.0</td>
<td>109.83</td>
<td>1.084</td>
<td>94.34</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>109.83±0.1</td>
<td>1.084±0.147</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Glucose Standard using Anthrone Reagent

9-point Linear Regression: R²=0.9973
### Table 2: Tabulated results of samples absorbance for protein analysis

<table>
<thead>
<tr>
<th>Protein Analysis of <em>Hibiscus sabdariffa</em> calyces, seeds, and leaves</th>
<th>Samples</th>
<th>Average Volume (µL)</th>
<th>Average Mass (mg)</th>
<th>Average Absorbance (nm)</th>
<th>Concentration (mg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyx</td>
<td>100</td>
<td>224.70</td>
<td>0.513</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>100</td>
<td>224.60</td>
<td>0.540</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>Leaves</td>
<td>100</td>
<td>224.80</td>
<td>0.508</td>
<td>0.41</td>
<td></td>
</tr>
</tbody>
</table>

**Standard lyophilized bovine gamma globulin (IgG)**

7-point Linear Regression: \( R^2 = 0.9936 \)

### Table 3: Average tabulated results of lipid content of *Hibiscus sabdariffa* leaves, seeds, and calyces

<table>
<thead>
<tr>
<th>Lipid Analysis of <em>Hibiscus sabdariffa</em> calyces, seeds, and leaves</th>
<th>Samples</th>
<th>Average Start Mass (mg)</th>
<th>Dry weight</th>
<th>Average Final Mass of Organic Layer after solvent extraction (mg)</th>
<th>Organic layer mass relative to average mass (mg/mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyx</td>
<td>312.70</td>
<td>240.40</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>312.70</td>
<td>250.27</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td>312.70</td>
<td>235.60</td>
<td>0.75</td>
<td></td>
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</tr>
</tbody>
</table>

### Table 4: Heavy Metal Analysis of *Hibiscus Sabdariffa* Calyces, Seeds, and Leaves looking at Sodium, Potassium, Calcium, Magnesium, and Iron

<table>
<thead>
<tr>
<th>Heavy Metal Analysis of <em>Hibiscus sabdariffa</em> calyces, seeds, and leaves</th>
<th>Sorrel Samples</th>
<th>Volume (µL)</th>
<th>Average Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sodium (mg/L)</td>
<td>Potassium (mg/L)</td>
</tr>
<tr>
<td>Calyxes</td>
<td>100</td>
<td>3.29</td>
<td>95.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.29±0.403</td>
<td>95.15±0.131</td>
</tr>
<tr>
<td>Seeds</td>
<td>100</td>
<td>2.53</td>
<td>69.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.53±0.028</td>
<td>69.72±0.686</td>
</tr>
<tr>
<td>Leaves</td>
<td>100</td>
<td>3.29</td>
<td>37.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.29±0.021</td>
<td>37.89±1.711</td>
</tr>
</tbody>
</table>

**Standard Plot**

Correlation (\( R^2 \)): 0.9985

### Table 5: Heavy Metal Analysis of *Hibiscus Sabdariffa var. sabdariffa* Calyces, Seeds, and Leaves looking at Copper

<table>
<thead>
<tr>
<th>Heavy Metal Analysis of <em>Hibiscus sabdariffa</em> calyces, seeds, and leaves</th>
<th>Sorrel Samples</th>
<th>Volume (µL)</th>
<th>Average Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Copper (µg/L)</td>
<td></td>
</tr>
<tr>
<td>Calyxes</td>
<td>100</td>
<td>47.74</td>
<td>47.74±3.012</td>
</tr>
<tr>
<td>Seeds</td>
<td>100</td>
<td>101.24</td>
<td>101.24±24.409</td>
</tr>
<tr>
<td>Leaves</td>
<td>100</td>
<td>27.17</td>
<td>27.17±10.635</td>
</tr>
</tbody>
</table>

**Standard Plot**

Correlation (\( R^2 \)): 0.9980