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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 Malaysia[1]. Much work has been reported on its effectiveness against life threatening diseases in other parts of the world, treating many cardiovascular disorders, helmenthic disease and cancer[2]; 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 foods[3]".

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 hypertension [4]", 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 variety[5] 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 consumption[6,7-14]. 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 method(s)[15] at Northern Caribbean University. Analysis for carbohydrate[16,17-18], protein[19] and lipids[20] were done at Northern Caribbean University. Nitric acid digestion of samples was also done at Northern Caribbean University for heavy metal analysis [21] 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.

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APPENDICES - A

List of Table

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

Carbohydrate analysis of *Hibiscus sabdariffa* calyxes, seeds, and leaves					
Samples	Average Volume (ml)	Average Mass (mg) Dry weight	Average Absorbance (nm)	Concentration (Mg of glucose/volume of test sample×100)	Concentration relative to average mass
Calyx	1.0	109.80	1.455	66.23	0.60
		109.80±0.1	1.455±0.038		
Seed	1.0	109.83	0.917	105.26	0.96
		109.83±0.1	0.917±0.033		
Leaves	1.0	109.83	1.084	94.34	0.86
		109.83±0.1	1.084±0.147		
Glucose Standard using Anthrone Reagent					
9-point Linear Regression: R^2 =0.9973					

Table 2: Tabulated results of samples absorbance for protein analysis

Protein Analysis of *Hibiscus sabdariffa* calyxes, seeds, and leaves				
Samples	Average Volume (µL)	Average Mass (mg) Dry weight	Average Absorbance (nm)	Concentration (mg/mL)
Calyx	100	224.70	0.513	0.42
		224.70±0.1	0.513±0.002	
Seed	100	224.60	0.540	0.71
		224.60±0.1	0.540±0.008	
Leaves	100	224.80	0.508	0.41
		224.80±0.1	0.508±0.005	
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 calyxes

Lipid Analysis of *Hibiscus sabdariffa* calyxes, seeds, and leaves			
Samples	Average Start Mass (mg) Dry weight	Average Final Mass of Organic Layer after solvent extraction (mg)	Organic layer mass relative to average mass (mg/mg)
Calyx	312.70	240.40	0.77
Seed	312.70	250.27	0.80
Leaf	312.70	235.60	0.75

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

Heavy Metal Analysis of *Hibiscus sabdariffa* calyxes, seeds, and leaves						
Sorrel Samples	Volume (µL)	**Average Reported**				
		Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Iron (mg/L)
Calyxes	100	3.29	95.15	121.93	5.09	0.48
		3.29±0.403	95.15±0.131	121.93±20.336	5.09±0.672	0.48±0.071
Seeds	100	2.53	69.72	83.58	1.33	0.52
		2.53±0.028	69.72±0.686	83.58±1.351	1.33±0.092	0.52±0.212
Leaves	100	3.29	37.89	121.93	6.06	0.96
		3.29±0.021	37.89±1.711	121.93±12.205	6.06±2.432	0.96±0.156
Standard Plot						
Correlation (R^2):		0.9985	0.9995	0.9918	0.9988	

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

		Average Reported
Sorrel Samples	Volume (µL)	Copper (µg/L)
Calyxes	100	47.74
		47.74±3.012
Seeds	100	101.24
		101.24±24.409
Leaves	100	27.17
		27.17±10.635
Standard Plot		
Correlation (R^2):		0.9980