

DETERMINATION OF LEAD AND CADMIUM IN HIBISCUS SABDARIFFA (CALYXES, SEEDS, AND LEAVES), GROWN IN JAMAICA'S MINED BAUXITE RICH SOIL

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Abstract: Presence of lead and cadmium in sorrel have been reported in other parts of the world. This study sought to explore presence as applicable to local grown and consumption of traditional red variety as samples were grown in mined bauxite rich soils reported to have these cumulative toxins. Seeds had higher concentrations of cadmium; leaves had higher concentrations of lead. All samples had trace amounts of lead and cadmium. While the heavy metals reported in earlier studies (iron, sodium, potassium, calcium, magnesium, and copper) could enhance human health, the potential toxicological effect of lead and cadmium present in known consumable portions of plant recommend moderate consumptions, modern methods to grow void of these toxins, or possible isolation of nutraceutical compounds to gain maximum health benefits. Cyanidin and delphinidin for example were reported to inhibit epidermal growth factor receptor in cancer cells, both of which were reported present in sorrel calyxes. Sorrel calyxes and leaves extracts were reported effective against cancers. The presence of these anthocyanins and their reported effect on cancerous cells underscores the plants nutraceutical potentials, whilst presence of lead and cadmium urge caution.

Keywords: Sorrel, Nutraceutical, Extract, Heavy Metals, Anthocyanins.

1. INTRODUCTION

Presence of lead and cadmium in sorrel have been reported in other parts of the world¹; however, this study sought to explore presence as applicable to local grown and consumption. Sorrel plants used in study were cultivated in the parish of Manchester, Jamaica, mined for bauxite over several years². The presence of cadmium and lead in sorrel extracts was indicative of bauxite mining zone³, and of such, the potential toxicological effects of these elements were of concern in this known nutraceutical plant. In other studies, “significant correlations were found between soil and agricultural produce concentrations for cadmium and lead in Jamaica ($r^2 \geq 0.5$)”⁴, which raised concern on rate and quantity of consumption once grown in bauxite rich soil, or method of growing this nutraceutical plant void of lead and cadmium. Soil test prior to planting may be warranted, or isolation of nutraceutical compounds for maximum health potential.

Per the World Health Organization, (WHO), “cadmium levels in fruit, meat and vegetables are usually below $10\mu\text{g}/\text{kg}$ ”⁵, or 0.01ppm. The main consumable portions the calyx reported an average of $5.16\mu\text{g}/\text{L}$ or 0.00516ppm in this study. There is no identified safe blood lead level; however, the Centers for Disease Control and Prevention (CDC) recommends that doctors begin monitoring children who have a blood lead level measured as 5 micrograms per deciliter ($\mu\text{g}/\text{dL}$) or

0.05ppm, concern levels for adults too per the Agency for Toxic Substances and Disease Registry. At this level it is recommended parents, doctors, public health officials, and communities -take steps to reduce the child's future exposure to lead^{6,7-8}. The average reported in main consumable portion in this study, calyx had 5.09µg/L or 0.00509ppm. While the study indicated trace amounts of cadmium and lead in main consumable portions, the net benefit of consumption of sorrel grown in bauxite rich soil remain of concern as heavy metals such as cadmium are reported to be human carcinogens⁹, while at the same time, sorrel have been reported effective against cancer(s) in local studies here at Northern Caribbean University and around the world^{10,11}. Its anti-cancer properties are believed to correlate with its flavonoid content.

Flavonoids represent a large class of secondary plant metabolites, of which anthocyanins are the most conspicuous class, due to the wide range of colors resulting from their synthesis¹². Anthocyanins have been reported present in many plants with important functions in plant physiology as well as possible health effects¹³. Of the health effects reported, cyanidin and delphinidin were reported to inhibit epidermal growth factor receptor in cancer cells, while malvidin was noted to be less effective¹⁴. *Hibiscus sabdariffa* calyxes have been reported to possess delphinidin-3-O-sambubioside (Dp-samb) and cyanidin-3-O-sambubioside (Cy-samb)¹⁵, which may correlate to its anti-cancer properties observed locally and reported in other studies. The presence of these anthocyanins and their reported effect on cancerous cells underscores the plants nutraceutical potential, whilst presence of lead and cadmium urge caution.

2. MATERIALS AND METHODS

Sorrel plants were grown in the parish of Manchester, Jamaica. Sorrel samples were prepared from modified method(s)¹⁶ at Northern Caribbean University. Nitric acid digestion of samples was also done at Northern Caribbean University for heavy metal analysis¹⁷ before analysis at Jamaica Bureau of Standards for lead and cadmium. Chromatographic separation of samples via Reverse Phase High Performance Liquid Chromatography were adopted to confirm presence of anthocyanin in samples at Northern Caribbean University^{18,19}. Analysis done in the year 2011.

3. RESULTS AND DISCUSSION

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. While the concentrations were relatively low, leaves had higher lead concentrations compared to calyxes, and seeds. Likewise, seeds had higher cadmium concentrations compared to leaves and calyxes (table 1). The presence of these cumulative toxins while being in trace amounts call for methods to grow this nutraceutical void of lead and cadmium or isolation of nutraceutical compounds to maximize health potentials.

Calyxes and leaves provided five retention times each, with three distinct peaks in calyxes and five in leaves. Concentrations were lower in leaves based on absorbance (Figure 1,2). Seeds had no chromatographic response. The presence of anthocyanins in sorrel calyxes and leaves based on methods adopted correlates to anticancer properties as observed locally and reported in many studies and may play a part as anti-inflammatory and as chemo-preventative agents since anthocyanins such as cyanidin and delphinidin were reported to inhibit epidermal growth factor receptor in cancer cells. The seeds did not show any compounds that were of benefit apart from those that reported earlier²⁰. These results showed that sorrel calyxes and leaves possess compounds that are important in addressing various health problems. This study shows that sorrel calyxes, seeds, and leaves have potential health benefits that may help in the prevention and treatment of diseases and that mitigation might be necessary to maximize health potential.

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APPENDIX - A

Table 1: Heavy Metal Analysis of *Hibiscus Sabdariffa* var. *sabdariffa* Calyxes, Seeds, and Leaves looking at Lead and Cadmium.

		Average Reported	
Sorrel Samples	Volume (µL)	Lead (µg/L)	Cadmium (µg/L)
Calyxes	100	5.09	5.16
		5.09±1.846	5.16±0.368
Seeds	100	3.34	15.68
		3.34±0.226	15.68±0.127
Leaves	100	16.41	14.07
		16.170±7.170	14.07±5.586
Standard Plot			
Correlation (R ²):		0.9999	0.9992

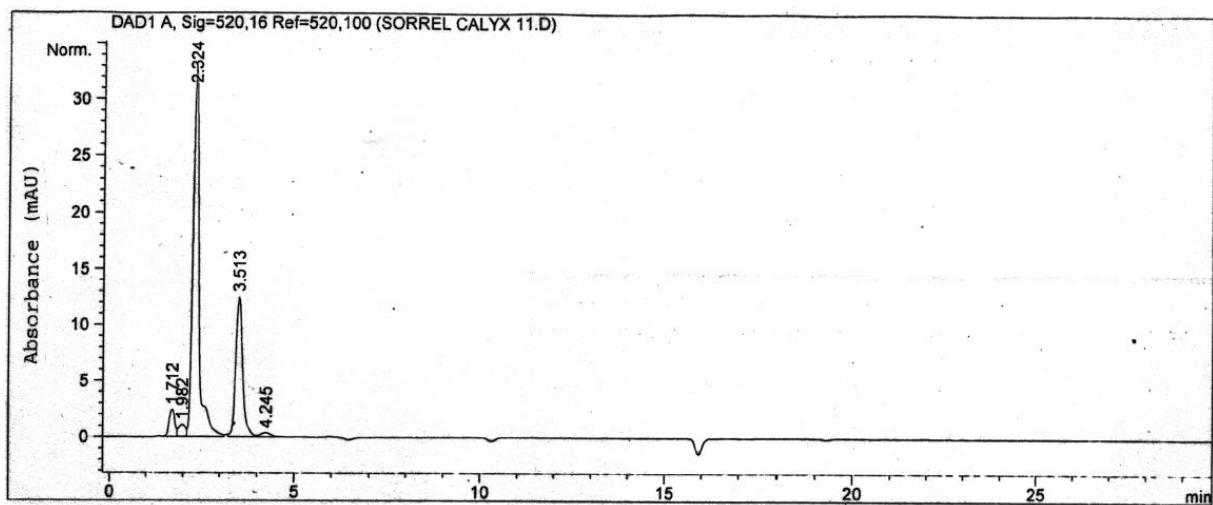


Figure 1: HPLC chromatograms of *Hibiscus sabdariffa* (Jamaican sorrel) Calyx samples

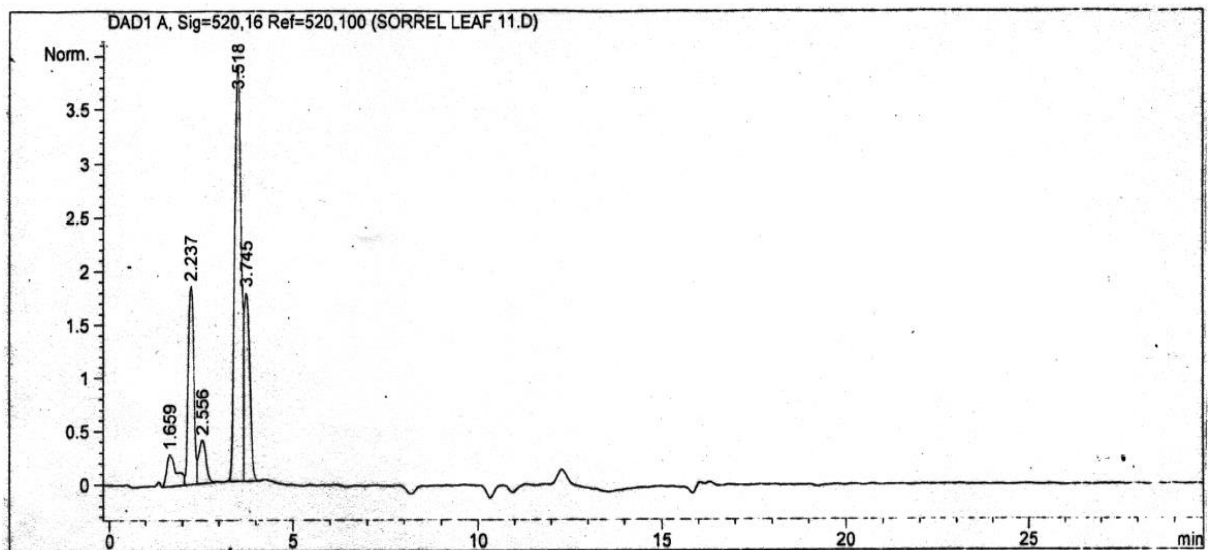


Figure 2: HPLC chromatograms of *Hibiscus sabdariffa* (Jamaican sorrel) Leaf samples