GLADSTONE ROAD AGRICULTURAL CENTRE
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PRELIMINARY EVALUATION OF THE LEAF AND ROOT NUTRIENT COMPOSITION OF A FRESH MARKET BEET (*BETA VULGARIS* L. VAR. *CRASSA* L.) VARIETY

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ABSTRACT

The beet variety 'Dakota' was analysed to determine the nutrient and mineral content of its leaf and root. The moisture contents of both leaf and root tissues were very high, at around 90%. Proximate analyses revealed differences in the leaf and root nutrient contents. A higher percentage of protein was stored within the beet leaf (1.7%) compared to that stored within the root (1.3%). The fat content was also higher in the leaf (0.2%) than in the root (0.03%). The results indicate that the root and leaf of the beet variety 'Dakota' are excellent sources of nutrition and can be recommended as a part of a nutritionally balanced diet.

Plate 1. Freshly harvested beet roots with leaves attached, grown at the Gladstone Road Agricultural Centre during 2013

Introduction:

The beet (*Beta vulgaris* L. var. *crassa* L.) is a root vegetable that is cultivated in many countries around the world. It belongs to the same family as the Swiss chard (*Beta vulgaris* L. var. *cycla* L.), which is a special variety of beet developed for its leafy above ground parts, rather than for its roots. The beet produces a leafy top and a swollen root that are both used as food. The root of the beet plant is used as a cooked vegetable, is manufactured into sugar, or is processed into pharmaceuticals, while the tops are used as a leafy green vegetable. The beet is also an important component in animal feeds (Belal, 2007).

It is important in the sugar industry, providing more than 40% of the raw materials used in the world for the manufacture of raw sugar (Koljajić, *et al.*, 2003). Twenty percent of the world's sugar production comes from beets (FAO, 2009). The sugar beet is an important alternative to sugarcane, particularly in the temperate zones where sugarcane is not grown.

Generally, root vegetables are a good source of vitamins and minerals. The leaves and roots of beets are high in vitamins A and C (Lintas, 1992), while the potassium content is generally high (Mengel, 1980). The beet roots are also high in carbohydrate content (Ahmad *et. al*, 2012). Beet leaves have a high protein content, are good digestive aids and contain mineral compounds that help complete deficiencies of both micro and macro elements (Dzida, *et al.*, 2011).

The beet is well adapted to many environmental conditions, is very resistant to cold and is fairly tolerant of heat and saline conditions (Milford *et al*., 1977; Abdel-Mawly and Zanouny, 2004; Ahmad *et. al*, 2012). When cultivated as a leafy green vegetable, the beet has a very short growing season and is not demanding of soils.

Beets are not cultivated on a large scale in The Bahamas, but are grown as a specialty crop for a specialised market. Introduction of this crop to a wider market will mean that local farmers must select varieties that are high yielding, resistant to pests and diseases and generally meet the demands of production and quality. Therefore, it is essential to evaluate beet varieties, for yield performance and for insect and disease tolerance.

Objectives:

The objective of this preliminary study was to analyse and compare the leaf and root nutrient composition of the beet variety 'Dakota'.

Materials and Methods:

A single beet variety, 'Dakota', was evaluated for its leaf and root nutrient composition at the Gladstone Road Agricultural Centre during January of 2013. The seeds were set out in a seed bed during October of 2012. After about four weeks, when the plants achieved between two and four mature leaves and a well developed root system, they were transplanted in double rows to raised beds of 100 ft length. Plant spacing was 8 in (20 cm) between plants within the rows. The rows were 5 ft (1.5 m) apart. The rows were irrigated using a drip irrigation system which supplied water throughout the short growing season. The leaves were sprayed weekly, using a combination of Xentari® and Bravo® with Nutrileaf® liquid

fertiliser in a 20-20-20 formulation, as a preventative measure against insect pests and diseases. Weeds were controlled by hand weeding.

Randomly selected leaf and root samples were cleaned to remove dirt and submitted to the Food Safety and Technology Laboratories of the Department of Marine Resources for analyses. The leaves and roots were processed, then analysed for nutrient and mineral composition and the values expressed on a dry matter basis. Quality characteristics measured included, moisture, dry matter, protein, crude fat, sodium and potassium.

Methods Used in Analysis of beet leaves and roots (Based on A.O.A.C., 1995):

Moisture/Dry Matter – leaves and roots were wiped and chopped into small pieces. Triplicate 2g samples were accurately weighed into pre-labelled, pre-weighed dishes and were dried at 130°C to constant weight. Dried samples/dishes were weighed. Moisture content (%) was calculated. Dry matter (%) was calculated by 100 – Moisture content (%).

Other Analyses - Samples were peeled, wiped, chopped and dried in oven. The dried samples were subsequently powdered in a high-speed blender and used for the remainder of the tests.

Protein - Duplicate 1g dried and powdered samples were weighed and digested with H_2SO_4 and K_2SO_4/Se catalyst tablets, using the block digestion method in a Foss Tecator Auto Digestor. The resulting digest was steam distilled into boric acid using a Labconco Rapid Still II. Titration of the distillate with standard HCl was used to estimate crude protein. The method was based on the A.O.A.C. Official Method 2001.11.

Fat - Fat determination carried out by the acid hydrolysis method. 8g samples were weighed in triplicate and digested in acid. The digests were transferred to Monjonnier flasks where the fat was extracted with ethers. The ether extract was transferred into previously dried and weighed flasks and the ethers evaporated and the remaining fat dried and weighed and the % fat calculated.

Sodium and Potassium - Aqueous solutions of ashed samples were aspirated directly into a Cole-Parmer Model 2655-00 flame analyzer. Intensity was compared against a prepared standard curve.

The mean daily maximum and minimum temperatures for the trial period were 27.8^{o}C (82.1^{o}F) and 20.9^{o}C (69.7^{o}F), respectively. The total rainfall for the period was 246.1 mm (9.69 in). Mean monthly sunshine duration for the period was 7.7 h. Weather information (Table 1) was obtained from the Meteorological Department of The Bahamas.

Table 1. Weather data on rainfall, hours of sunshine and mean maximum and minimum temperatures for New Providence for the period of October 2012 to January 2013, courtesy of the Meteorological Department of The Bahamas.

Month	Total rainfall (mm/inches)	Mean monthly radiation (h)	Mean maximum temperature (ºC/ºF)	Mean minimum temperature (ºC/ºF)
October 2012	**155.4**/6.12	**7.4**	**30.2**/86.3	**23.8**/74.9
November 2012	**24.9**/0.98	**8.1**	**26.9**/80.5	**19.8**/67.7
December 2012	**58.9**/2.32	**7.6**	**26.9**/80.5	**19.8**/67.7
January 2013	**6.86**/0.27	**7.6**	**27.2**/81.0	**20.2**/68.4

Note: Monthly mean values have been rounded up to the nearest tenth.

Results:

Post harvest quality characteristics are outlined in Table 4. The beet variety displayed an acceptable root colour, root shape and general appearance (Plate 1). There was no evidence of any serious pest or disease problems. The beet leaves were fairly tender, free of insect damage, and without visible signs of decay. They were of an acceptable quality based on the USDA standards for grades of beet leafy greens (USDA-AMS, 2008). The beet roots were fairly smooth, well shaped and were within market standards for grades of beet roots (USDA-AMS, 1997).

Table 4. Post-harvest quality characteristics of beet variety 'Dakota' evaluated at the Gladstone Road Agricultural Centre during 2013.

Stated number of days to maturity from transplanted seedlings	Actual number of days to maturity from transplanted seedlings	Interior colour	Leaf	Root shape	Visible signs of disease or chlorosis
60	64	Dark red	Red stem with glossy green leaves	Round	None

Table 5 presents a summary of measurements for the proximate analyses of the freshly harvested leaves and roots of the beet variety evaluated. The moisture content of both leaf and root tissue was very high, at around 90%. Protein content was highest in the leaves, at 1.7%, while the roots were estimated at 1.3%. Crude fat content observed was 0.03% in the roots and 0.2% in the leaves. There was insufficient leaf material to make a complete assessment of its mineral content; however the roots exhibited moderate quantities of sodium and potassium.

Table 5. Proximate analyses of the raw leaf and root of the beet variety 'Dakota'.

	MOISTURE %	**DRY MATTER %**	**PROTEIN %**	**FAT (CRUDE) %**	**SODIUM (MG/100G)**	**POTASSIUM (MG/100G)**
Leaf content	90.2	0.8	1.7	0.2	I/S	I/S
Root content	90.0	10.0	1.3	0.03	79.3	364.2

I/S: Insufficient Sample

Discussion:

Results from this preliminary trial are promising and suggest that the beet variety 'Dakota' can be grown successfully under local conditions. Analyses of the nutrient and mineral composition indicate that the roots and leaves of the beet variety are excellent sources of nutrition and can be recommended as a part of a nutritionally balanced diet. It is recommended that further studies be conducted to examine the yield performance of this variety along with additional beet varieties that might have the potential for local production.

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