

Original Research Article

## **Investigation of Nutritional Value of Selected Sri Lankan Traditional Root and Tubers**

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**Abstract:** Food crisis is one of the major global problems and finding solution to this is a huge challenge for researchers. Underutilized crops, with good nutritional potential and easily cultivable characteristics, are been recognize as a promising solution for this. There are number of underutilized root and tuber crops available in Sri Lanka. Most of their nutritional value has not been investigated yet. Hence this research attempt to investigate nutritional value of selected root and tuber crops available in Sri Lanka. Five varieties of *Dioscorea alata* including three Rajala cultivars, two Kahata angala cultivars and Elephant foot yam (*Amorphophallus paenoiifolius*) were used for the study. Proximate composition (moisture, crude protein, crude fat, crude fiber, ash and carbohydrate) and mineral composition (Fe, Cu, K, Zn, Na, Mg and Ca) of all those samples were analyzed. All studied varieties found to be rich in all studied nutritional components equally or over the presently cultivated root and tubers. Out of the root and tubers studied, the highest nutritional composition recorded for Elephant foot yam. Hence, it can be concluded that the selected varieties of underutilized root and tuber crops exist a great nutritional potential.

**Keywords:** *Dioscorea alata*, Nutritional, Proximate, Root and tuber, Mineral.

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### **INTRODUCTION**

Many of the developing countries have been facing the problem of food scarcity due to continued high population growth rate, rapid urbanization, environmental degradation and climatic changes, etc [1]. Hence, acquiring the ability to reduce the adverse effect of hunger and starvation is a huge challenge. Some underutilized crops with good nutritional potential and easily cultivable characteristics are been recognize as a promising solution for this problem. Underutilize root and tuber crops are highly tolerant to adverse environmental conditions and higher in nutritional value. Therefore, those are best suite to fulfill the future food demand.

Recently more than 55 Traditional/ Indigenous root and tuber crop species have identified in Sri Lanka [2]. Several researches have focused on the nutritional compounds of different root and tuber crops in different parts of the world [3-6]. However only limited number of researches have been carried out on nutritional value of the traditional root and tuber crops available in Sri Lanka [7]. Therefore, there is a need for studies of nutritional value in such traditional Root and Tuber crops. Thus, this study was carried out mainly focusing on nutritional value of some traditional root and tuber in

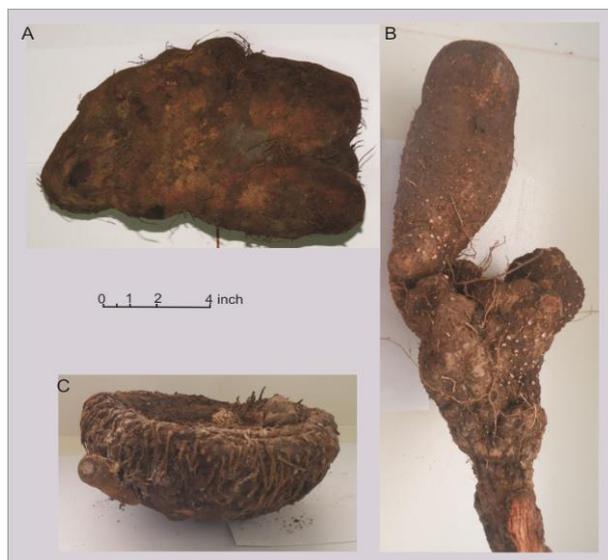
Sri Lanka. Moreover, nutritional values of selected root and tuber were compared with the same of cassava because cassava is the highly utilizing root crop in the Sri Lanka.

### **METHODOLOGY**

Six varieties of traditional Root and Tubers including three Rajala (*Dioscorea alata*) cultivars, two Kahata angala (*Dioscorea alata*) cultivars and Elephant foot yam (*Amorphophallus paenoiifolius*) (Fig-1) were selected for this study considering their high availability and distribution throughout the country. Samples of selected root and tubers were collected and identified using an information guide prepared by Godamulla [2]. Then laboratory samples of each selected and identified root and tubers were prepared. Those prepared laboratory sample were used for the proximate composition analysis. Proximate composition (moisture, ash, crude fat, crude protein, and crude fiber) of samples were analyzed in triplicate using Association of Official Analytical Chemists (AOAC) approved methods [8]. Moisture content of the samples was determined by drying a known weight of the sample in an oven at 105°C to constant weight. The loss in weight of the sample was calculated as moisture content. Ash content was determined by incineration of known

weight of the dried sample in a muffle furnace at 550°C for 7 hours and the weight of inorganic matter was taken after incineration. Ash percentage was calculated on dry weight basis. Crude protein was determined by Kjeldahl method. Crude fiber was determined after digesting a known weight of fat-free sample in 1.25% sulphuric acid and refluxing in 1.25% sodium hydroxide. Crude fat was quantified from dried samples by soxhlet extraction method using petroleum ether as

solvent and percentage fat calculated on dry weight basis. Carbohydrate was estimated by calculating the percent remaining after all the other components have been measured: % carbohydrates = 100 - [% moisture + % protein + % lipid + % mineral]. All the data were analyzed using one-way ANOVA using Minitab 16 statistical software. Mean comparisons were done by using Tukey method.



**Fig-1: Morphology of selected roots and tubers A- Rajala, B-Kahata angala and C-Elephant foot yam**

Minerals content of the selected samples were analyzed by using Atomic Absorption Spectroscopic method. In this method ash were prepared by dry ashing method (550 °C/7 hours). For each and every ash samples 0.2000 g was measured in to vessels and digested with 5 ml conc. HNO<sub>3</sub> (AR grade Sigma Aldrich) and top up to 25 ml volumetric and filtered with whatman 42 filter paper and store in refrigerator. Then, Samples were digested using MARS 6 Microwave digestion system in the MARS Xpress vessels. Subsequently, digested samples were analyzed for Fe, Cu, K, Zn, Na, Mg and Ca using high-sensitive double-beam optics Shimadzu AA-7000 Atomic Absorption Spectrophotometer.

## RESULTS AND DISCUSSION

The proximate chemical composition of water yams (*Dioscorea alata*) and elephant foot yam

(*Amorphophallus paenoiifolius*) are presented in Table 1. Statistical analysis showed significant differences ( $P < 0.05$ ) among the means of the nutritional components estimated for the tested samples. Highest moisture, crude protein and crude fibre contents were observed in Rajala cultivar<sup>1</sup> (*D. alata*). Highest crude fat, ash and carbohydrate contents were observed in Kahata angala cultivar<sup>2</sup> (*D. alata*), Elephant foot yam and Rajala cultivar<sup>2</sup> (*D. alata*) respectively (Table 1).

Lowest moisture and crude protein contents were observed in Rajala cultivar<sup>2</sup> (*D. alata*) and Rajala cultivar<sup>3</sup> (*D. alata*) respectively. Lowest crude fat and carbohydrate contents were observed in Elephant foot yam. Lowest crude fibre was observed in Kahata angala cultivar<sup>2</sup> (*D. alata*). Lowest ash contents were observed in Kahata angala cultivar<sup>2</sup> (*D. alata*) and Kahata angala cultivar<sup>1</sup> (*D. alata*) (Table 1).

**Table 1: Proximate composition of root and tuber crop varieties**

	Moisture content %	Crude protein %	Crude fat %	Crude fibre %	Ash %	Carbohydrate %
Rajala <sup>1</sup>	84.3±0.27 <sup>a</sup>	7.60±0.24 <sup>a</sup>	0.55±0.06 <sup>d</sup>	2.30±0.27 <sup>a</sup>	1.80±0.01 <sup>d</sup>	90.1±0.29 <sup>ab</sup>
Kahata angala <sup>1</sup>	80.0±0.06 <sup>c</sup>	5.14±0.47 <sup>b</sup>	0.66±0.03 <sup>c</sup>	1.55±0.06 <sup>b</sup>	1.72±0.02 <sup>d</sup>	92.5±0.33 <sup>a</sup>
Rajala <sup>2</sup>	69.0±0.06 <sup>f</sup>	6.57±1.86 <sup>ab</sup>	0.83±0.02 <sup>b</sup>	1.20±0.01 <sup>c</sup>	2.10±0.10 <sup>c</sup>	91.9±2.71 <sup>a</sup>
Kahata angala <sup>2</sup>	77.3±0.58 <sup>d</sup>	5.81±0.29 <sup>ab</sup>	1.71±0.02 <sup>a</sup>	1.01±0.07 <sup>c</sup>	1.72±0.01 <sup>d</sup>	90.8±0.30 <sup>a</sup>
Elephant foot yam	74.1±0.01 <sup>e</sup>	6.90±0.96 <sup>ab</sup>	0.32±0.06 <sup>c</sup>	1.61±0.01 <sup>b</sup>	5.88±0.03 <sup>a</sup>	86.9±0.92 <sup>b</sup>
Rajala <sup>3</sup>	82.3±0.17 <sup>b</sup>	5.10±0.10 <sup>b</sup>	0.51±0.04 <sup>d</sup>	2.01±0.02 <sup>a</sup>	3.11±0.01 <sup>b</sup>	91.3±0.13 <sup>a</sup>

Means with the same superscripts in the same column are not significantly different ( $P < 0.05$ )

Resulted nutritional composition of the selected samples in this study was comparable with previous similar studies [7, 9]. Cassava is one of the most commonly utilize traditional root crop in Sri Lanka. The results of the present study were compared with the nutritional value of cassava. In Previous studies [10], cassava genotypes showed crude protein values ranged from 1.2 to 1.8 %. Studied root and tuber varieties clearly showed that higher crude protein content (Table 1) than that of cassava. The other nutritional components of all tested samples were in the same level of those of cassava.

Results of the mineral composition analysis of the selected root and tubers are shown in table 2. Further, results of the mineral analysis except potassium are illustrated in fig.2. Resulted Fe, Cu, K, Zn, Na, Mg and Ca content were ranged 0.99 - 5.71, 0.74 - 2.29, 328.11 - 114.04, 0.47 - 6.71, 1.45 - 3.25, 11.11 - 44.66 and 1.09 - 61.26 mg/100g respectively.

All tested samples shown to be containing higher amount of potassium. Similar results have been reported for the K content of root and tubers in previous studies [7]. In those previous studies chemical fertilizer application has been proposed as a possible reason for high potassium contents of root and tubers [7]. However, for our study samples were collected from home gardens where chemical fertilizer has not been applied. Hence, the reason for the high potassium content of tested samples cannot be the high chemical fertilizer application and that can be the own high potential of tested root and tubers to absorb potassium from the soil. Out of the tested samples highest K content was shown by Elephant foot yam while lowest K content shown by Kahata angala<sup>1</sup>. High dietary K plays a protective role in humans against hypertension, stroke, cardiac dysfunctions, renal damage, hypercalciuria, kidney stone and osteoporosis [11]. As such, the high availability of K in studied root and

tubers can be recognized as their health benefit. Na to K ratio of the studied root and tubers also calculated (Table 2) as this ratio is considered as an important concern for the prevention from the disease high blood pressure. To consider a food as a healthy food the Na/K ratio should be less than one [12]. The Na/K of all tested root and tubers were less than one and as such those will not promote high blood pressure. Out of tested samples Elephant foot yam showed the lowest Na/K ratio.

In addition to high potassium content, high magnesium content also observed in all samples. Mg helps to maintain osmotic equilibrium when its presence in the plasma and extracellular fluid [12]. Hence, this also confirms the health benefits of studied root and tubers.

Nearly 32 % of children in Sri Lanka are suffered from Iron deficiency anemia [13]. As a result of this, limits work performance and impaired mental and motor functions are showing in children. Tested root and tubers, especially Elephant foot yam, found to be containing considerable amount of Iron. Consumption of tested root and tubers especially Elephant foot yam, can reduced the chances of nutritional anemia due to their high iron content which is adequate to meet the daily allowance of Iron [14].

Considerable amount of Zn and Ca was also observed in tested samples. Out of those significantly high Zn and Ca contents were found in Elephant foot yam. Zn is involving in the synthesis and degradation of macro nutrients and metabolism of micronutrients. In addition to that, Zn is important to enhance human immunity [14]. Ca intake of the body is important to prevent or may be therapy for the hypocalcaemia conditions such as osteoporosis [15]. Lowest Zn and Ca contents were recorded from Kahata angala 1 and 2.

**Table 2: Mineral composition of root and tuber crop varieties in Sri Lanka (mg/100 g)**

	Fe	Cu	K	Zn	Na	Mg	Ca	Na/K
Rajala <sup>1</sup>	1.34	1.36	123.49	0.51	1.45	12.97	4.78	0.0117
Kahata angala <sup>1</sup>	1.01	0.71	114.04	0.47	3.25	11.46	1.11	0.0285
Rajala <sup>2</sup>	1.58	1.58	137.77	0.61	1.68	15.80	5.37	0.0122
Kahata angala <sup>2</sup>	0.99	0.74	117.32	0.52	3.16	11.11	1.09	0.0269
Elephant foot yam	5.71	2.18	328.11	6.71	3.13	44.66	61.26	0.0095
Rajala <sup>3</sup>	2.49	2.29	206.83	0.87	2.49	22.20	8.51	0.0120

When compare the mineral content of tested samples elephant foot yam found to be containing comparatively high amount of mineral studied. Out of those minerals, K, Mg and Ca were found in high quantities than other minerals. In similar studies carried out in other countries elephant foot yam has been recognized as the root and tuber which contained the highest amount of minerals [13, 16, 17]. As such, the

results of present study are in agreement with the results of those studies.

When compare the mineral composition of tested different cultivars of same roots and tubers, no difference were observed in the results. Mineral composition of tested rajala cultivars and kahata angala cultivars were in same level. Further, the results of minerals analysis were compared with the mineral

content of cassava which is one of the highly used root and tuber crops in Sri Lanka. The mineral content of all

test root and tubers were found to be higher than that of cassava or in similar level [18, 19].

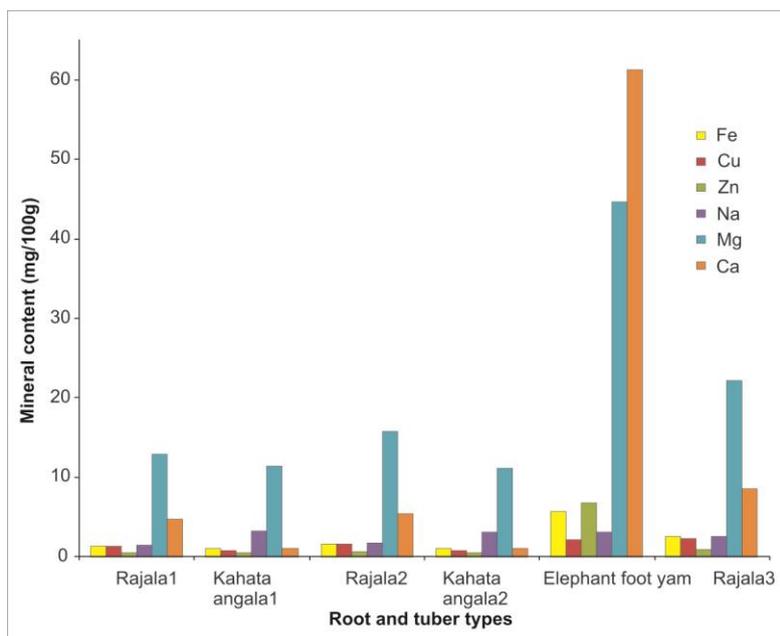


Fig-2: Mineral content of selected root and tuber growing in Sri Lanka

According to the results of this study all studied roots and tubers shown to be with good nutritional qualities. Out of the studied roots and tubers, Elephant foot yam showed the highest nutritional qualities. Further, Elephant foot yam has been recognized as a plant with many health benefits in studies carried out in other counties [13]. Elephant foot yam has been used in traditional medicine in Sri Lanka as well. However, study on those medicinal properties of Elephant foot yam was beyond the scope of this study.

## CONCLUSION

According to the results of the study, all selected root and tuber crops possessed higher nutritional value. Crude protein values of these crops were even higher than that of cassava, which is most commonly used at present. Resulted mineral composition of the selected samples revealed that, mineral content of all the samples are in appropriate level to consider them as the healthy food. Mineral content of tested samples were also higher than the same of cassava or in the same level with cassava. Hence these crops can be recommended as promising underutilized crops which can be helpful in reducing food scarcity. Elephant foot yam of Sri Lanka can be recommended as the best out of all tested root and tubers in this regards as it recorded the highest nutritional properties among tested samples.

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