

Preliminary Study of Mineral Constituents in Selected Cultivars of Root and Tuber Crops in Sri Lanka

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Abstract

A study was done to determine the levels of minerals (Calcium, Magnesium, Iron, Potassium and Zinc) in three different cultivars of yams (*D. alata* and *D. esculenta*), *Xanthosoma* sp and four different cultivars of sweet potatoes (*Ipomea batatas* Lam) from different regions in Sri Lanka. Yams (Rajala, Hingurala and Kukulala), *Xanthosoma* sp (Kiriala) and sweet potatoes (Swp3, Swp4, Swp5 and Swp7) were prepared for analysis 2 – 3 days after harvesting. Flour samples were subjected to ashing using AOAC (1980) method and mineral constituents were analysed using Atomic Absorption Spectrophotometer (AAS). Variation in mineral constituents on dry weight basis were analysed using ANOVA, Tukey's HSD test ($p < 0.05$) Minitab. All three cultivars of yams had significant levels ($p < 0.05$) of Calcium and Iron and high level of Magnesium was observed in Kiriala (45.27 ± 0.31 mg $100g^{-1}$). A significantly high level of Iron and Potassium ($p < 0.05$) was observed in Rajala and Sweet potatoes respectively. Swp5 cultivar contained a comparatively high amount of Calcium and Magnesium while Swp3 and Swp7 contained a high level of iron ($p < 0.05$). Comparatively high level of Zinc was present in Hingurala, Swp3 and Swp7 cultivars.

Key words: *Dioscorea* , *Ipomea batatas*, minerals, *Xanthosoma* sp

Introduction

Root and tuber crops are efficient solar energy transferors and are grown in the tropical regions and consumed as primary, secondary or supplementary staple. With a minimum amount of agricultural inputs and with less favourable conditions they can transfer solar energy into rich stores of starch. Roots and tuber crops can be eaten boiled, roasted, fried or cooked. *Dioscorea alata* and *Dioscorea esculenta* are the two main yam species commonly found in Sri Lanka and the Family: Dioscoreaceae, is a genus consisting of 630 identified species. Nearly 40 *Dioscorea* varieties are grown in Sri Lanka (Jayasuriya, 1995). *Dioscorea* are seasonal crops and generally planted at the end of March to April. With the signs of yellowing leaves and withered vines mature crop is usually ready to harvest around December to February. Starch is the main component in the yams (60 - 85% dry basis) and forms an important component in the diet of individuals living in rural areas of Sri Lanka (Jayakody et al, 2007).

Sweet potatoes (*Ipomea batatas* Lam) are also commonly consumed due to the availability throughout the year. The sweet potato is a tuberous – rooted perennial plant belonging to the Convolvulaceae or morning glory family. This family includes about 45 genera and 1000 species, but only *Ipomea batatas* is of economic importance as a food (Onwueme, 1978). Generally a plant produces 4 – 7 tuberous roots at maturity (Chandra et al, 1985).

Xanthosoma sagittifolium (Kiriala) species is also commonly consumed as it is available throughout the year. *Xanthosoma* spp are commonly known as new cocoyams (Kiriala) and the immature stems of the studied variety contains a red line on the either side of the stem and the leaves contain blue- green pigments. A corm is produced at the base of the plant and this bears 10 to 15 lateral cormels (Kay, 1973). Sweet potatoes (*Ipomea batatas* Lam), yams (*Dioscorea* sp) and *Xanthosoma sagittifolium* (Kiriala) can be considered as nutritionally important tuber crops because of their high energy contribution as in the form of starch and also contain various amounts of mineral components. After harvesting, these tuber crops upon passing a certain dormancy period may make sprouts if favourable conditions are met. This will bring a considerable amount of dry matter and water loss (Onwueme, 1982). However, if the tubers are properly stored these tubers can be made available throughout the year.

This study was aimed to assess the mineral composition of flours of three different cultivars of yams, Kiriala (figure 1) and four cultivars of sweet potatoes (figure 2), commonly cultivated in Sri Lanka. Yams and Kiriala samples were collected from Gannoruwa, Kandy and sweet potato samples which contained white and slight orange flesh were obtained from Horana, Gokarella and Dhambulla areas. Samples were prepared for analysis two to three days after harvesting.

Materials and Methods

Materials

Matured tubers of *Dioscorea alata* (Rajala and Hingurala), *Dioscorea esculenta* (Kukulala) and *Xanthosoma sagittifolium* (Kiriala) samples were collected from Horticultural Crop Research & Development Institute, Gannoruwa, Kandy. Matured tubers of sweet potatoes namely, swp 5 (Malaysian variety), swp 7 (CARI 273) and swp 3 (Wariyapola white) and swp 4 (Pallepola variety) were collected from Dhambulla and Horana areas respectively. Random samples of sweet potatoes were selected from market areas and the cultivars have been identified at the Horticultural Crop Research and Development Institute, Gannoruwa, Kandy, Sri Lanka. Flour samples were prepared for analysis, two to three days following harvesting.

Flour preparation

The tubers were washed, hand peeled and trimmed to remove defective parts. The tubers were grated into thin chips (~ 5 mm) and dried in an air convection oven at 40 °C for 30 hours up to 14% moisture. The dried chips were powdered using a laboratory scale grinder (Sumeet CM/L 2128945) and sifted through 300 µm sieve. The flour samples were sealed and packed in air tight containers for further analysis.

Mineral composition analysis

Mineral elements (Ca, Mg, Fe, K and Zn) were determined by the dry ashing method, (AOAC,1980). The ash was dissolved in Conc. HCl, filtered and diluted to 50 ml with distilled water. Prepared solutions were analysed with standards for elemental analysis by an Atomic Absorption Spectrophotometer (GBC Avanta Ver 1.33).

Results and Discussion

The mineral composition of yams, *Xanthosoma* spp and sweet potatoes are shown in Table 1. All three varieties of yams were rich in Calcium and there was no significant difference ($P>0.05$) in Calcium levels of yams while a comparatively low level was found in Kiriala. A high level of Iron was observed in *Dioscorea alata* (Rajala) than in other yams and Kiriala. The highest Magnesium level was observed in Kiriala and yams contained comparatively lower levels.



Figure 1. Morphology of Yams and Kiriala

Significant levels of Potassium were observed in all the samples. A significantly high ($p < 0.05$) level of Potassium was observed in Rajala and comparatively low levels were found in Kiriala and other two cultivars of yams. All the samples contained lower levels of Zinc compared to analyzed mineral matter and a significantly high level ($p < 0.05$) of zinc was found in Hingurala compared to other yams and Kiriala. Literature reveals very low levels of minerals in Nigerian varieties of *D.alata* species (Okwu et al, 2006). These *Dioscorea* varieties contained Magnesium, Calcium and Potassium in the ranges of 0.5 – 1.1, 1.2 – 2.41 and 0.39 – 1 mg/ 100 g dry weight respectively which appears to be considerably lower than the Sri Lankan cultivars studied. More Ca, Mg and Fe were observed in Sri Lankan cultivars than the cultivars studied by Oke, 1990 and Ishida et al, 2000. However the Potassium level in the Sri Lankan yams was similar to the levels found in yams studied by Oke, 1990 and Ishida et al, 2000. These values depend on various factors such as cultivar type and environmental factors. Therefore further studies concerning the mineral constituents of these cultivars would give a more conclusive view of the environmental impact on the mineral contents of these cultivars.

Table I. Mineral levels of different cultivars of yams, *Xanthosoma* sp and sweet potatoes on dry weight basis (mg /100g dry weight)

Source	Calcium	Iron	Magnesium	Potassium	Zinc
<i>D. alata</i> (Rajala)	8.13± 0.05 ^a	7.17± 0.11 ^a	35.11± .29 ^b	206.99± 4.94 ^d	1.07±0.05 ^e
<i>D. alata</i> (Hingurala)	8.15 ±0.29 ^a	6.22± 0.2 ^b	31.34±1.16 ^c	184.21± 1.92 ^f	2.11± 0.1 ^b
<i>D. esculenta</i> (Kukulala)	8.29± 0.06 ^a	6.12± 0.03 ^b	33.6± .19 ^b	190.91± 0.78 ^e	1.19± .08 ^d
<i>Xanthosoma</i> <i>sagittifolium</i> (Kiriala)	6.36± 0.31 ^b	6.21± 0.31 ^b	45.27± .31 ^a	184.15± 1.6 ^f	1.16±0.15 ^d
(Swp3)	2.1±0.1 ^d	6.2±0.9 ^b	11.0±0.8 ^e	805.6±5.7 ^a	2.5±0.3 ^a
(Swp4)	3.4±0.8 ^d	4.5±0.9 ^c	12.1±0.1 ^e	708.5±2.7 ^b	1.9±0.1 ^c
(Swp5)	5.9±0.1 ^c	4.2±0.1 ^c	15.3±0.1 ^d	526.8±2.3 ^c	1.6±0.1 ^c
(Swp7)	2.2±0.1 ^d	6.3±0.2 ^b	11.0±0.3 ^e	691.5±5.9 ^b	2.6±0.1 ^a

Data represent the mean of three replicates, Values followed by the different superscript in each column are significantly different ($P > 0.05$)

Calcium level range between 2.1±0.1 to 5.9±0.1 mg/100 g db and swp5 contains a significantly higher level ($P > 0.05$) than the other 3 cultivars. Calcium range in sweet potatoes studied by Oke, 1990 and Ishida et al, 2000 was in the range of 11 – 36 mg/ 100g while Fe and Mg are in the ranges of 0.9 – 9.6 and 26 – 27 mg/ 100 g db respectively. The studied cultivars contain comparatively lower levels of Ca and Mg while a similar level of Fe reported in literature. A significant level of iron ($P < 0.05$) was

observed in swp3 and swp7 than the other two varieties. A high level of Magnesium was present in swp5 compared to other varieties. Considerable levels of Potassium and zinc was observed in swp1 and the lowest level of Potassium was found in swp5 (Table 1).



Malaysian variety (SWP5)

CARI 273 (SWP7)

Figure 2. Morphology of Sweet potatoes

Low levels of Potassium were reported in findings of Oke, 1990 and Ishida et al, 2000. A significantly high level of Calcium and Magnesium was present in Malaysian cultivar while there was no significant difference ($p>0.05$) in the levels of Calcium in other three cultivars of sweet potatoes. A comparatively significant level of iron was observed in white skinned sweet potato (Wariyapola white) and orange fleshed CARI 273 than the other two cultivars. A significantly high level ($p> 0.05$) of Potassium was observed in Wariyapola white and a comparatively lower level was found in the Malaysian cultivar (table 1). A significantly high level ($p> 0.05$) of Zinc was observed in white skinned sweet potato and CARI 273 cultivar than in Pallepola and the Malaysian cultivar.

Compared to sweet potatoes a high level of Calcium and Magnesium were observed in yams and Kiriala (Table 1). Significant levels of Iron were observed in the yams studied, Kiriala and Swp3 and Swp7 cultivars of sweet potatoes. A high level of Potassium was observed in all the sweet potato cultivars than in yam and Kiriala while a comparatively high level of Zinc was observed in Hingurala, Wariyapola white and CARI 273 of the studied root and tuber crops.

Conclusions

Flours obtained from yams and *Xanthosoma* sp contained considerable levels of Calcium and Magnesium on dry matter basis compared to the sweet potatoes studied. There was no significant difference in the Calcium, Magnesium and Iron levels in the studied yam varieties and a considerably higher amount of Iron and Magnesium was observed in Rajala and Kiriala respectively than in the other root and tuber crops. A considerably high amount of Potassium was present in all the studied sweet potatoes than in yams and Kiriala. Significant levels of Zinc were observed in Hingurala, white skinned sweet potato and orange fleshed sweet potato compared to other tubers studied.

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