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Analyzing Proximate Composition of Macro Nutrients of Sri Lankan Cassava Variety "Kirikawadi"

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Abstract: Cassava (*Manihot esculenta*) which is considered as the third most important food source in tropics is a cheap and reliable food source for people in developing countries. This study was sought to analyze the proximate (moisture, ash, total fat, crude fibre, protein and carbohydrate) in the peel and the flesh of "Kirikawadi" variety. The proximate composition (moisture, ash, crude fibre, protein and total fat) of the six samples was determined using standard methods with three replicates. The carbohydrate content was calculated by the difference. The peel contain significantly high amount of moisture (72.63±0.67%), fat (0.68±0.08%), protein (1.73±0.09%) and fibre (2.31±0.02%) than the flesh, where the flesh contain significantly ($p<0.05$) high amount of ash (1.32±0.03%) and carbohydrate (33.73±1.69%). A negative correlation was significantly exist in between the moisture content of the flesh, the fat content and carbohydrate content of flesh. The protein content in the flesh was correlated negatively and significantly with the protein content of the peel. There was a significant positive correlation exist in between carbohydrate content and the fat content in the flesh.

Key words: Cassava, proximate composition, macro nutrients, kirikawadi, cassava peel, cassava flesh

INTRODUCTION

Cassava (*Manihot esculenta*) is a cheap and reliable source of food for more than 700 million people in the developing countries (Eleazu and Eleazu, 2012; FAO, 2003). It is considered as the third most important food source after rice and maize (Bradbury *et al*., 1991) and a major metabolic sources of energy for millions in the tropics. Cassava is also an important raw material for industrial uses (Pensiri and Sandra, 2000). Cassava is a drought-tolerant perennial root crop and has a flexible harvesting calendar with vegetative propagation of low-cost (Haggblade *et al*., 2012).

In Sri Lanka, the estimated annual production of cassava in year 2014 is 302,767 Metric tons and the area of land under cultivation of cassava is 23,970 Hectares (National Accounts of Sri Lanka, 2014). Cassava is an unexploited tuber crop while having high demand in both local and export markets in Sri Lanka (Wijesinghe and Sarananda, 2008).

Starchy storage root which is reported as with good nutritional quality is the main commercial product of cassava. Raw cassava root has three distinctive areas as phelloderm (peel), parenchyma and central vascular core. The bulk of the root is called the parenchyma. The outer layer commonly known as peel comprises with 3 parts as outer epidermis, sub-epidermis and a thicker inner layer (Juan *et al*., 2011).

This study was sought to analyze the proximate (moisture, ash, total fat, crude fibre, protein and carbohydrate) in the peel and the flesh of "Kirikawadi" variety. Such baseline information will be useful for increasing the food use and the industrial utilization of selected cassava variety.

MATERIALS AND METHODS

Sample collection: The samples of cassava roots of variety "Kirikawadi" was collected from the experimental fields of Horticultural Crop Research and Development Institute (HORDI), Gannoruwa, Sri Lanka. Six cassava plants in the same maturity stage were randomly selected. The plants were harvested at the age of twelve month from plantation.

Sample preparation: Harvested samples were packed in shallow, rigid, ventilated plastic crates and labeled. Then they were immediately transported carefully to the laboratory at the Department of Food Science and Technology, University of Sri Jayewardenepura. At the laboratory the samples were cleaned to remove the soil particles and packed in to polyethylene bags. Samples were stored in refrigerated condition (Temperature 4°C to 0°C) until taken to analysis (Maximum duration 2 weeks).

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Proximate composition analysis of samples: The samples stored in refrigerator were taken and the peel was removed carefully from the flesh. The peels were separately collected and upper epidermis of the peel was removed carefully. The rest of the peels and flesh of the tubers were ground using mortar and the pestle to decrease the particle size and taken in to analysis. The proximate composition (moisture, ash, crude fibre, protein and total fat) of the six samples was determined using standard methods with three replicates (AOAC, 1980). The carbohydrate content was calculated by the difference.

The moisture content was determined gravimetrically using oven dried method through drying 5 g of the samples in a moisture dish until obtained a constant weight at 105°C.

The protein content was determined using micro kjeldhal method of nitrogen analysis. About 0.05 g of each sample was digested with concentrated sulphuric acid using Lead containing kjeldhal tablet catalyst. The digest was distilled with NaOH and liberated ammonia is collected in to 5 ml of 4% w/v boric acid solution and titrated with 0.02 M HCL acid in the presence of Kjeldhal indicator. The crude protein in the samples was obtained by multiplying the Nitrogen content of the sample from a conversion factor 6.25.

Ash content was determined gravimetrically by ashing 1g of each sample in to reweighed porcelain crucibles in a Muffle furnace at 550°C for 24 h.

Total fat or crude fat content of each sample was determined by extracting the fat of the dried food material with HCl acid.

An acid alkaline hydrolysis method was used to determine the crude fibre content. Approximately 2 g of the sample was boiled with 0.1 M sulphuric acid and 0.1 M Sodium hydroxide respectively and filtered the content through a Buchner funnel in to a ash less filter paper. Then filter paper with the filter bad was dried and ashed at 550°C.

Carbohydrate content was calculated with following formula:

$$\begin{bmatrix}\text{Carbohydrate}\\ \text{content}\end{bmatrix} = 100 \times \begin{bmatrix}\text{Moisture+ash+protein}\\ \text{+fat+crude fibre}\end{bmatrix}$$

Statistical analysis: The data were analyzed using MINITAB 14 statistical software. The results of proximate composition were subjected to normality test for examine whether the observations were normally distributed. The compositions of flesh and peel were analyzed using paired t test at 95% confident level. Simple linear correlation coefficients were determined for proximate composition parameters. The relationship between significant proximate composition parameters of the peel and the flesh was predicted using a linear regression model (Mead and Curnow, 1983).

RESULTS AND DISCUSSION

According to the performed normality test all the observations of proximate analysis in the flesh and the peel were normally distributed ($p>0.05$). Therefore the paired t test was performed.

Proximate composition analysis of the flesh: The results of proximate composition analysis in the flesh and the peel of roots are shown in Table 1.

Moisture is as essential nutrient for life maintenance and it plays a vital role in determining roots post-harvest storage (Treche, 1995). The moisture content of the flesh was 62.92±1.85% and the range (33.14-45.86%) is higher than those reported by Emmanuel *et al.* (2012) of six traditional cassava varieties in Ghana. That might be a result of differences in sample preparation of cassava root for analysis. The root samples was dried at 60°C for 48 h and grounded to obtain flour. The observed range of moisture of "Kirikawadi" cassava variety was in between the range of 65 to 74% as reported by Wheatley and Chuzel (1993) on four cultivars of cassava and 60.3 to 87.1% as reported by Padonou *et al.* (2005) on twenty improved cassava cultivars.

The inorganic mineral content in the sample is reflected by the ash content of the sample. The observed ash

Table 1: Proximate compositions in the root flesh and the root peel of Cassava variety "Kirikawadi" wet basis

	Flesh	Peel
Moisture	62.92±1.85	72.63±0.67
Ash	1.32±0.03	1.20±0.04
Fat	0.41±0.14	0.68±0.08
Protein	0.72±0.09	1.73±0.09
Fibre	0.90±0.02	2.31±0.02
Carbohydrate	33.73±1.69	21.45±0.72

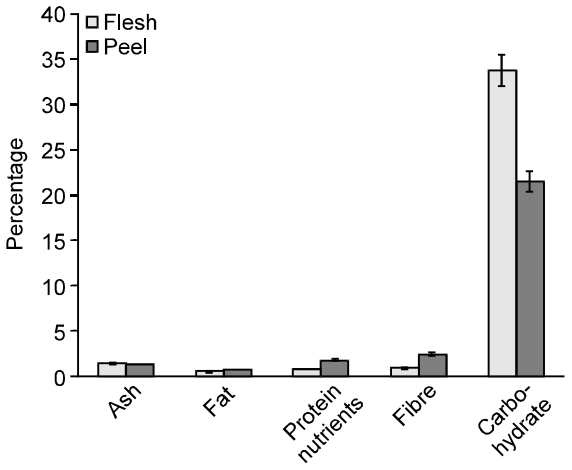

Fig. 1: Proximate compositions in the root flesh and the root peel of cassava variety "Kirikawadi" wet basis

content of cultivar was 1.32±0.03% and it was comparable to the range 0.4-1.7% as reproted by Montagnac *et al*. (2009).

Fat which is vital to the structure and biological functions of cells and act as alternative energy source (Eleazu and Eleazu, 2012), content in the sample was 0.41±0.14%. The observed value was tallied with the range (0.1 to 0.4%) reported by Charles *et al*. (2005) of five cassava genotypes and with the range (0.03 to 0.5%) reported by Montagnac *et al*. (2009).

The crude protein content of Kirikawadi root flesh sample was 0.72±0.09%. The observed value was comparable with the range (0.4-1.5%) reported by Bradbury and Holloway (1988) and with the range (0.3-3.5%) reported by Montagnac*et al*. (2009).

Crude fibre content which is mainly made up of cellulose and a little amount of lignin, helps to increase the bulk of stool (Eleazu and Eleazu, 2012). According to Gil and Buitrago (2002) crude fibre content in fresh cassava roots does not exceed the limit 1.5% and that was comparable with the observed crude fibre content (0.90±0.02%) of the sample.

The carbohydrate in fresh cassava roots was reported by Montagnac *et al*. (2009) as ranging from 25.3 to 35.7% in the review of Nutrition value of cassava and the observed carbohydrate content in the "Kirikawadi" sample (33.73±1.69%) was comparable with it.

Proximate composition analysis of the peel: The moisture, ash, Fat, protein, fibre and carbohydrates amounts of the peel sample was 72.63±0.67, 1.20±0.04, 0.68±0.08, 1.73±0.09, 2.31±0.02 and 21.45±0.72% (Table 1). Those observed values are lower than those reported by Okpako *et al*. (2008) and by Oboh (2006). That might be because of the ranges were on dry basis and the varietal changes of cassava cultivars.

The results of paired t-test which was carried out to compare the mean differences of proximate compositions of peel and the flesh of "Kirikawadi" root reveals that there was a significant difference ($p<0.05$) exist in between the proximate compositions. The peel contain significantly high amount of moisture (72.63±0.67%), fat (0.68±0.08%), protein (1.73±0.09%) and fibre (2.31±0.02%) than the flesh, where the flesh contain significantly ($p<0.05$) high amount of ash (1.32±0.03%) and carbohydrate (33.73±1.69%) (Fig. 1). The observations were comparable with Montagnac *et al*. (2009) which reported as the protein, fat and fibre contents were found in larger quantities in the root peel than in the peeled root and the flesh has higher amount of carbohydrates.

Table 2 illustrates the correlation matrix for the proximate composition contents in cassava peel and the flesh. The results presented shows that the moisture content of the flesh was correlated negatively and significantly with the fat content of the flesh ($p<0.05$) and carbohydrate content of flesh ($p<0.05$) (Fig. 2a-b).

Table 2: Correlation matrix for proximate composition contents in cassava peels and flesh

	Moisture flesh	Moisture peel	Ash flesh	Ash peel	Fat flesh	Fat peel	Protein flesh	Protein peel	Fibre flesh	Fibre peel	Carbo. flesh	Carbo. peel
Moisture flesh	1.0000											
Moisture peel	0.2124	1.0000										
Ash flesh	-0.1102	0.3265	1.0000									
Ash peel	0.9133	0.5289	0.0381	1.0000								
Fat flesh	-0.9438	-0.3503	0.0326	-0.8514	1.0000							
Fat peel	0.2529	0.5670	0.4451	0.2549	-0.5440	1.0000						
Protein flesh	-0.3966	0.2191	-0.0466	-0.4325	0.0905	0.6199	1.0000					
Protein peel	0.5193	-0.1142	0.1817	0.5627	-0.2429	-0.4442	-0.9689	1.0000				
Fibre flesh	0.6736	-0.4796	-0.1684	0.3823	-0.5782	-0.0086	-0.3408	0.4437	1.0000			
Fibre peel	0.5012	-0.3511	-0.7533	0.1902	-0.5152	0.0170	0.1061	-0.1444	0.5603	1.0000		
Carbohydrate flesh	-0.9997	-0.2165	0.1056	-0.9102	0.9505	-0.2728	0.3763	-0.5029	-0.6776	-0.5046	1.0000	
Carbohydrate peel	-0.3520	-0.9874	-0.3511	-0.6458	0.4722	-0.5870	-0.1253	0.0001	0.3513	0.3013	0.3558	1.0000

Carbo: Carbohydrate

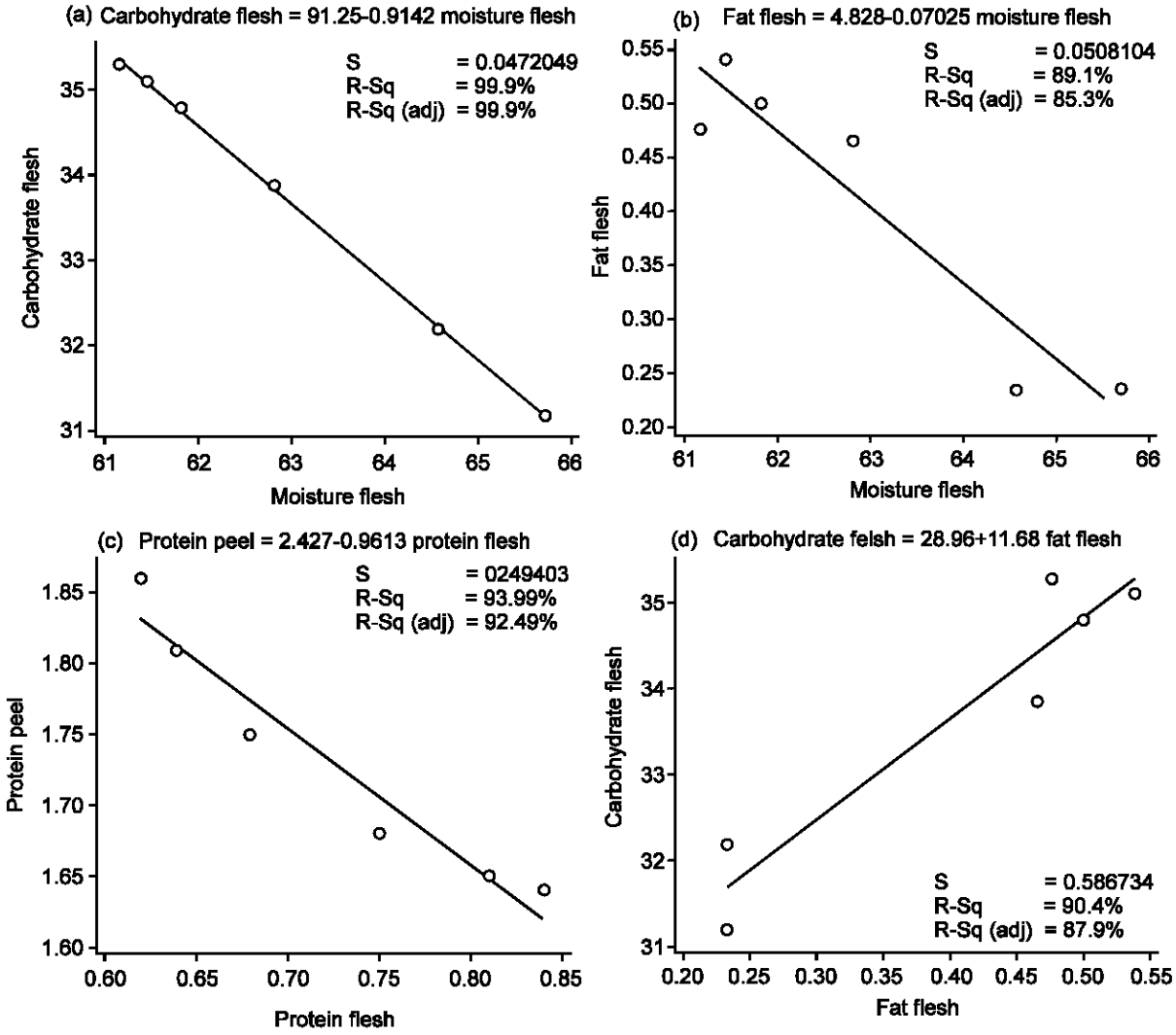

Fig. 2: Relationship between proximate composition parameters: (a) carbohydrate in flesh and moisture in flesh, (b) Fat in flesh and moisture in flesh, (c) Protein in peel and protein in flesh, (d) carbohydrate in flesh and fat in flesh

The protein content in the flesh was correlated negatively and significantly ($p<0.05$) with the protein content of peel. There was a significant ($o<0.05$) positive correlation exist in between carbohydrate content in the flesh and the fat content in the flesh (Fig. 2c-d).

Conclusion: The peel contain significantly high amount of moisture, fat, protein and fibre than the flesh, where the flesh contain significantly high amount of ash and carbohydrate content. A negative correlation was significantly exist in between The moisture content of the flesh, the fat content of the flesh and with carbohydrate content of flesh. The protein content in the flesh was correlated negatively and significantly with the protein content of the peel. There was a significant positive correlation exist in between carbohydrate content in the flesh and the fat content in the flesh.

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