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Analysis of total carbohydrate and total cyanide content in varieties of cassava (*Manihot esculenta* Crantz) Tubers

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Abstract

Cassava (*Manihot esculenta* Crantz) tubers are a one of the most important source of carbohydrate. The plant tuber is also known to have the ability to produce hydrogen cyanic acid which is toxic to living organisms. This research was intended to investigate the total carbohydrate content, which is a nutritional parameter and cyanide content, an anti-nutritional compound in five varieties of cassava tubers in order to quantitatively provide the knowledge about the energy content and toxic content present in the five varieties. This study also gives a comparison of total carbohydrate and total cyanide among the selected five varieties of cassava. The results of the work shows that among the five varieties Sree Vijaya have the greater amount of carbohydrate (298.1 ± 2.10 mg/g), were as the carbohydrate content of Mulluvadi, Sree Jaya, Malayan, and Swarna were 271.4 ± 1.76 mg/g, 266.0 ± 1.41 mg/g, 284.4 ± 0.80 mg/g and 276.2 ± 1.15 mg/g respectively. The total cyanide content in Mulluvadi is 121.42 ± 0.22 μ g/gm, Sree Vijaya is 109.0 ± 0.31 μ g/gm, Sree Jaya 107.2 ± 0.42 μ g/gm, Malayan 73.06 ± 0.21 μ g/gm and for Swarna is 81.0 ± 0.14 . Among the five varieties Mulluvadi consist high amount of cyanide compared to others.

Keywords: *Manihot esculenta* Crantz, cyanogenic potential (CNP), total carbohydrate, total cyanide

1. Introduction

Cassava (*Manihot esculenta* Crantz) is one of the marked tuber crop cultivated in the world which is seen extensively in tropical and subtropical regions. Cassava belongs to family Euphorbiaceae and it is a perennial shrub. The plant tuber is determined as poor people's crop, as an inferior food crop and also as a dangerous crop (Oboh *et al.*, 2007) [17]. They are extensively known to having the presence of carbohydrate and cyanide content in their tubers. Cassava is one of the most important root crops and a source of energy with high calorific value in the tropical regions. Cassava tubers have nearly twice the calories than that of several other tubers like potatoes. After rice and corn, it is known to be the third largest carbohydrate food source within the tropical region (Ceballos *et al.*, 2004) [3]. More than 80% of carbohydrates produced are in the form of starch. About 83% of starch is in the form of amylopectin and 17% is in form of amylose (Rawel and Kroll 2003) [18].

Cassava is also known as the toxic tuber crop due to the presence of cyanide content. Cassava has a cyanogenic potential (CNP). This indicates that though not normally present in plant tissues, when the plant cells are bruised, crushed, grated or bitten cyanide (hydrogen cyanic acid) can be produced through enzymatic process which usually occurs in plant cells (Cooke and Marduagwu, 1985) [7]. Cyanide has the ability to inhibit the cells oxidative capacity and it later causes their destruction. The consumption of cyanide can be lethal to both human and animals. Cyanide doses of 50 to 100 mg are reportedly lethal to adults (Halstrom and Moller, 1945) [10]. The plant tuber toxicity can be reduced to some extent by adopting certain traditional techniques such as proper washing, chipping, soaking, and fermentation, cooking, steaming, drying and roasting. Even though this crop variety have got the presence of cyanogenic content, the demand of cassava tuber are increasing because of being rich in carbohydrate content, affordable among a major public and their ability to tolerate drought and low fertile soil.

The main objectives of this research are to investigate total carbohydrate content and total cyanide in five varieties of cassava.

2. Materials and Methods

This study is designed to determine the amount of total cyanide present in five varieties of cassava (*Manihot esculenta* Crantz) tubers namely: Mulluvadi, Sree Vijaya (Kariyila poriyam), Sree Jaya (Diwan kappa), Malayan-4 (M-4) and Swarna (Arumasa kappa).

2.1 Sample Collection

Freshly harvested tubers of cassava namely Mulluvadi, Sree Vijaya (Kariyila poriyam), Sree Jaya (Diwan Kappa), Malayan 4 (M-4) and Swarna (Arumasa kappa) were collected from the farm of CTCRI (Central Tuber Crop Research Institute), located at Sreekaryam, Thiruvananthapuram, Kerala, India.

3. Estimation of Total Carbohydrate

3.1 Sample preparation

The tubers were washed with distilled water and peeled. The cassava pulps were then again washed carefully with distilled water and separately diced in to smaller sizes. The samples were oven dried at 40°C for 18 h. Each sample was ground into fine powder using mortar and pestle and was used for analysis.

3.2 Total carbohydrate content: The total carbohydrate content was determined by anthrone reagent method (Hedge *et al.*, 1962) [11]. One gram of powdered sample was weighed in to a boiling tube. 10ml of distilled water was added into it. The solution was filtered out and was centrifuged at 10,000 rpm for 10 minutes. The supernatant was made in to a known volume using distilled water. 0.1 ml of sample was taken and made it up to 1ml by distilled water. Four milli litres of anthrone reagent was added in to it and kept in boiling water bath for 10 minutes. Absorbance was measured as OD and was read at 620nm.

4. Estimation of Total Cyanide

4.1 Sample preparation

The freshly harvested cassava tubers was peeled, cut into small pieces and carefully washed with distilled water. The cyanide content can varies both radially and longitudinally (Bradbury *et al.*, 1991 and Chávez *et al.*, 2005) [1, 4], by removing both the stem end and the distal end of the tuber a homogenous sample was obtained and it was cut in to smaller cubes. Then the sample was extracted with 0.1M orthophosphoric acid.

4.2 Total cyanide content

The total cyanide content was determined by extraction with 0.1M orthophosphoric acid (Cooke, 1978) [7] followed by the enzymatic assay and determination of cyanide by isonicotinic acid, and 2-methyl barbiturate (Essers *et al.*, 1993) [9].

5. Result and Discussion

The total carbohydrate and total cyanide content in five varieties of cassava tubers was investigated. The quantitative result of carbohydrate is given in the Table1.

Table 1: Total carbohydrate (mg/g) content of five varieties of cassava tubers

Cassava varieties	Total carbohydrate content (mg/g)
Mulluvadi	271.4 ±1.76
Sree Vijaya	298.1±2.10
Sree Jaya	266.0±1.41
Malayan	284.4±0.80
Swarna	276.2±1.15

The study shows that cassava variety Sree Vijaya possess greater amount of total carbohydrate content (298.1±2.10 mg/g). The rich carbohydrate content in the Sree Vijaya indicates their high nutritional value compared to other varieties. Lower amount of carbohydrate was observed in Sree Jaya (266.0±1.41 mg/g). The total carbohydrate content of Mulluvadi, Malayan and Swarna are 271.4 ±1.76 mg/g, 284.4±0.80 mg/g and 276.2±1.15mg/g respectively. Earlier workers (Bradbury and Holloway, 1998) [2]; Woot-Tsuen *et al.*, 1968, Favier, 1977 and Lancaster *et al.*, 1982) [19, 12] have found average carbohydrate content of cassava to be ranging from 300mg/g to 380 mg/g as against this study. The variation in the current study may be due to the fact that the collection of samples were done during mid-summer when the growth condition of the plants were not that favourable.

The total cyanide content of five cassava varieties is shown in the Table 2. The higher amount of cyanide content is seen in Mulluvadi (121.42±0.22µg/g) than that of others. The other cassava varieties like Sree Vijaya has 109.0±0.31µg/g, Sree Jaya 107.2±0.42µg/gm, Malayan have 73.06±0.21µg/g, and Swarna have 81.0±0.14µg/g amount of cyanide. The determination of cyanide compound content in cassava was described by Ngugi *et al.*, (2015) [16]. Various authors: Chiwona-Karlton *et al.*, (2004) [5] and Mkumbira *et al.*, (2003) [15] reports that there are two major cassava types, sweet and bitter. The reports are based on the content of cyanogenic glycosides. Dufour, (1984) [8] and McKey *et al.*, (2010) [14] identified that the bitter varieties contain more than 100 µg/g cyanogenic glycosides. They also reported that sweet varieties have less than 100 µg/g cyanogenic glycosides. Chiwona-Karlton *et al.*, (2004) [5] and Mader (2005) reports that more than 90% of production are of bitter varieties as their yield is substantially high, they are tolerant to a myriad of insects as well as pests and also they can be stored in soil for considerable time. In the current work, only Malayan and Swarna were found to have cyanogenic glycosides content lower than 100 µg/g of, whereas all other varieties were found to be bitter. But there are so many cooking techniques by which the cyanogenic glycosides can be avoided from affecting health of the consumers.

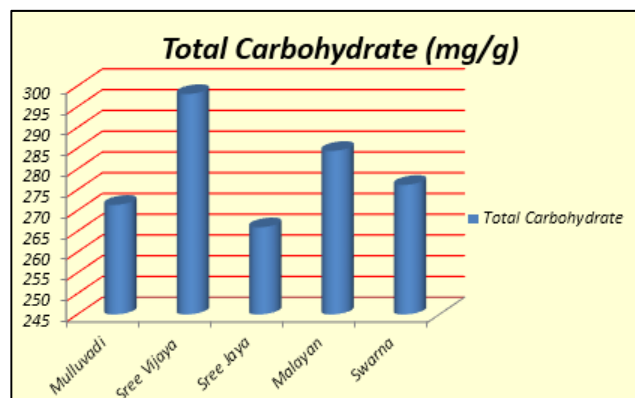


Fig 1: Total carbohydrate (mg/g) content of cassava varieties

Table 2: The total cyanide (µg/g) content in five varieties of cassava tubers

Cassava varieties	Cyanide content (µg CN/g)
Mulluvadi	121.42±0.22
Sree Vijaya	109.0±0.31
Sree Jaya	107.2±0.42
Malayan	73.06±0.21
Swarna	81.0±0.14

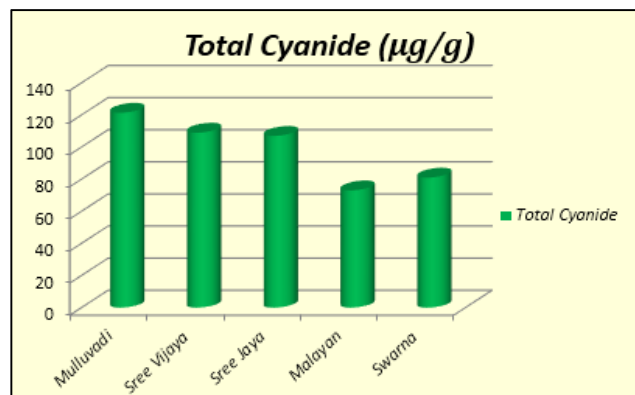


Fig 2: Total cyanide (µg/g) content of cassava varieties

6. Conclusion

Cassava (*Manihot esculenta*) tubers were considered as one of the most important staple food in many countries due to the presence of rich carbohydrate and also known as the dangerous crop by reason of cyanide presence. Concurrently, the present study gives a scenario on the fact that the carbohydrate and cyanide content can varies according to the varieties. In the present study among the five varieties Sree Vijaya cassava tuber have comparatively high amount of carbohydrate than the other cassava varieties whereas it is the cassava tuber named Mulluvadi which shows greater amount of cyanide content. Various traditional techniques can be adopted in order to remove the cyanide content from the tuber to a certain extent.

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