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Determination of Tannin, Phytate and Total Oxalate Content in Selected Varieties of Cassava (Manihot Esculenta Crantz) Tubers

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Abstract: ***Cassava (Manihot esculenta Crantz) tubers are known for their presence of carbohydrate content. But minor quantity of anti-nutrients is also present in the tuber. The present investigation is conducted to know about the minor anti-nutritional components present in the selected cassava tuber. The result of the work shows that among five selected varieties, Malayan contains high amount of tannin content which is 0.0575±0.001 mg/g when compared with other cassava varieties whereas Mulluvadi contains lower amount (0.0161±0.0025 mg/g). In case of Sree Vijaya it is 0.0168±0.0024 mg/g, Sree Jaya which is 0.0187±0.0018 mg/g, and Swarna contains 0.0358±0.0025 mg/g. The phytate and total oxalate content is high in Swarna which is of 0.378% phytate and 0.023±0.002mg/gm total oxalate. The Mulluvadi tuber contains 0.243% of phytate and 0.015±0.02 mg/gm of total oxalate. The amount of phytate in Sree Vijaya, Sree Jaya and Malayan are 0.361 %, 0.324% and 0.287% respectively, where as the total oxalate content Sree Vijaya, Sree Jaya and Malayan were 0.017±0.003 mg/g, 0.019±0.004mg/g and 0.013±0.010mg/g respectively.***

Keywords: Cassava (Manihot esculenta Crantz), Tubers, Tannin, Phytate, Total Oxalate

I. INTRODUCTION

From ancient time humans are greatly depending on roots and tubers for their basic food satisfaction. Tubers have an added advantage that no kind of poisonous chemical contamination is there as they are found underground and have minimum pest infestation. One of the major cultivated tuber crop is cassava. Cassava (Manihot esculenta Crantz) which is popularly known as tapioca in India is a widely cultivated tuber in the country, mainly because of their high tolerance capacity towards drought, salinity aswellas low fertile soil. Cassava is a perennial shrub and inferior tuber crop which belongs Euphorbiaceae family. The genus Manihot comprises 98 species and M.esculenta is the most widely cultivated member [12]. Cassava has found modern use as fuel and the roots of cassava are used as roughages for animal feed, because of its high fibre content mainly for herbivorous animals[1].Cassava root is a physiological energy reserve with high carbohydrate content, which ranges from 32% to 35% on a fresh weight (FW) basis, and from 80% to 90% on a dry matter (DM) basis,[6,3].Even though they contains high amount of carbohydrate like digestible starch certain anti-nutritional components also present in minor quantity. The natural or artificial factors which can interfere the absorption of nutrient is known as anti-nutrients [14]. Cassava tubers were also known for their presence of cyanide content. In addition to the cyanide, minor quantity of other anti-nutritional components such as tannin, phytate, total oxalate etc, also seen. Tannin belongs in the group of polyphenolic compounds, have the ability to chelate metals such as zinc, and reduce the absorption of the nutrients. They also inhibit digestive enzymes and may precipitate proteins [4]. Phytate (inositol hexakisphosphate) is compound, found in high abundance in cassava, with approximately 624 mg/100 g in roots [2]. The phytic acids have the capability to interfere with mineral absorption[8]. They also forms insoluble complexes with certain metals like calcium, zinc, iron and copper. Oxalate is also present in the cassava tuber in small quantity. Oxalate is a kind of molecule which occurs naturally especially found in plants and humans. It is non-essential to humans. Calcium oxalate stones can get form in kidney due to the crystallization of oxalate mainly by their extensive accumulation in body fluids,[7]. The carbohydrate metabolism can get disrupted due to increase in concentration of oxalate, [9]. In addition to this cyanide is the most important anti-nutrient component present in the cassava tuber.The earlier work conducted with the same selected cassava varieties shown that the total cyanide content in Mulluvadi is high (121.42±0.22µg/gm) when compared with the others, where as it is the tuber of Malayan contains lower amount of total cyanide which is 73.06±0.21µg/gm and in case of carbohydrate, the cassava variety named Sree Vijaya possess greater amount of total carbohydrate content (298.1±2.10 mg/g) and lower amount were observed in Sree Jaya which is 266.0±1.41 mg/g, [11]. These anti-nutrients present in the cassava tubers can be removed to some extent by adopting certain

methods of processing like, soaking, drying (sun-drying), proper cooking, fermentation etc. The amount of these components in the cassava tubers may varies depending on the varieties. The main objectives of the present investigation were, to quantitatively determine the amount of anti-nutritional components like tannin, phytate and total oxalate in the selected five varieties of cassava tubers.

II. MATERIALS AND METHODS

A. Study Material and Sample Collection

The cassava tubers namely: Mulluvadi, Sree Vijaya (Kariyila poriyan), Sree Jaya (Diwan Kappa), Malayan 4 (M-4) and Swarna (Arumasa kappa) which were freshly harvested and collected from the CTCRI (Central Tuber Crop Research Institute) farm located at Sreekaryam, Thiruvananthapuram, Kerala, India in 2017 are selected for this study.

B. Preparation of Sample

The freshly harvested tubers were initially washed with distilled water so that the soil adhered in the tuber gets washed away. Then the tubers were carefully peeled and washed again with distilled water in order to remove any excess dirt. The cleaned tuber samples were diced into small pieces separately. The diced samples were oven dried at 40°C for 18h. The oven dried samples were grounded into fine powder using motor and pestle.

C. Methods

1) Determination of tannin

One gram of ground tuber was extracted in 50% of methanol. The solution was mixed occasionally by swirling. The solution is then centrifuged after 20-28hrs and the supernatant was carefully collected. From the collected supernatant 1ml of it was pipette out. 5ml of vanillin hydrochloride reagent was added quickly into it. After 20 minutes the OD was read in spectrophotometer at 500 nm. Vanillin hydrochloride reagent alone was prepared as the blank. A standard graph was also prepared with 20-100µg using the diluted stock solution.

2) *Determination of phytate*

Two gm of powdered sample was weighed into 250 ml conical flask. 100 ml of 2% concentrated hydrochloric acid was used to soak the sample in the conical flask for 3 h and then the solution was filtered through double layered hardened filter papers. 50 ml of filtrate was placed in 250 ml beaker and 100 ml of distilled water was added to give proper acidity. 10 mL of 0.3% ammonium thiocyanate solution was added as indicator. Each solution was titrated with standard iron chloride solution, which contained 0.00195 g iron per ml. The end point color was slightly brownish - yellow which persisted for 5 min. The percentage phytic acid was calculated.

3) Determination of total Oxalate

One gram of powdered sample was extracted twice with 0.25 N HCL in a water bath (60°C) for one hour each. The solution is then centrifuged and the centrifugate was collected in a conical flask (around 40 ml). 5 ml of tungstophosphoric acid was added and mixed well. The solution was kept for overnight and centrifuged. The centrifugate was collected and neutralized with ammonia solution (1:1 diluted). The calcium oxalate is precipitated by adding 5 ml acetate buffer containing calcium chloride (pH 4.5). The solution was kept for overnight and centrifuged and washed the precipitate twice with wash liquid (6 ml each, pre cooled). The precipitate was then dissolved in 10 to 15 ml hot 2N sulphuric acid and transferred to a 100ml conical flask and titrated against 0.01N KMnO4 solution at 60°C.

III. RESULTS AND DISCUSSION

The results obtained from the quantitative estimation of tannin , phytate and total oxalate content is shown in the given Table:1

TABLE: 1, Showing the quantitative results of the anti-nutritional components in selected cassava tubers

Parameters	Mulluvadi	Sree Vijaya	Sree Jaya	Malayan	Swarna
Tannin(mg/g)	0.0161±0.0025	0.0168±0.0024	0.0187±0.0018	0.0575±0.001	0.0358±0.0025
Phytate (%)	0.243	0.361	0.324	0.287	0.378
Total oxalate(mg/g)	0.015±0.02	0.017±0.003	0.019±0.004	0.013±0.010	0.023±0.002

A. Tannin content

The data shown in Table:1 and Figure: 1 shows the tannin content present in the selected cassava tubers. The current study noticed that it is the tuber of Malayan which contains high amount of tannin (0.0575±0.001 mg/gm) when compared to other selected varieties. 0.0358±0.0025 mg/g of tannin was observed in the tuber of Swarna. Mulluvadi and Sree Vijaya tubers contains comparatively similar amount of tannin which is 0.0161±0.0025 mg/g and 0.0168±0.0024 respectively. The tuber of Sree Jaya contains medium quantity of tannin (0.0187±0.0018 mg/g) among the other varieties. Among the five varieties, it is the tuber of Mulluvadi which contains least amount of tannin (0.0161±0.0025 mg/gm).

The study of anti-nutitional parameters conducted in a study [13] shows that the tannin in the bitter cassava (0.60±0.22 mg/100gm) is higher than that of the sweet varitiey (0.40±0.01 mg/100gm).

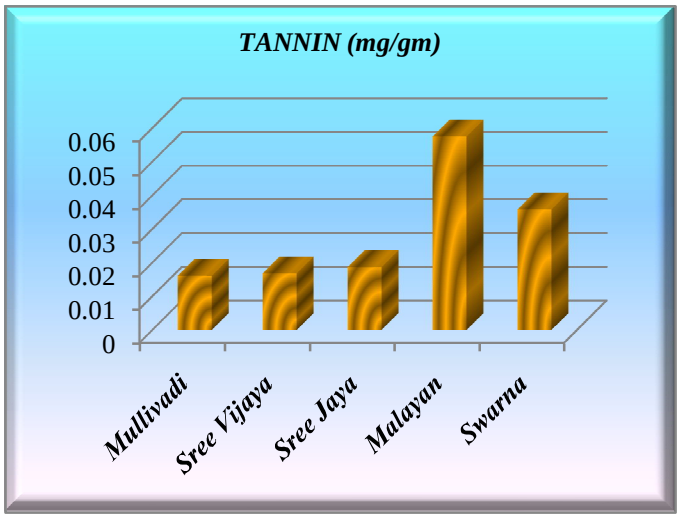

Figure:1, Tannin content in tubers of cassava varieties

B) Phytate content

The current study shows that the cassava varieties have only minute amount of phytate content, which can be reduced by cooking and fermentation methods. The quantitative data of phytate is given in the Table:1 and Figure:2. The tuber of Swarna contains high amount of phytate (0.378%) when compared with other cassava varieties. The lowest quantity observed is 0.243% which is in Mulluvadi tuber. The other varieties like Sree Vijaya, Sree Jaya and Malayan contains 0.361%, 0.324% and 0.287% of phytate concentration respectively.

The preceding workers [5] observed that the concentration of phytate was highest in the cassava varieties with 53.7±0.81 mg/100g for the sweet cassava and 62.4±1.29 mg/100g for the bitter cassava. Omosuli, [15] determined the phytate content in raw cassava tuber (3.36±0.07 mg/100gm) and compared with the boiled cassava tuber (0.79±0.007mg/100gm). Marfo *et al*., [2] identified that the phytate content of cassava roots is about 624 mg/100gm. Phytic acid is able to bind with cations such as magnesium, calcium, iron, zinc and molybdenum and can, therefore, interfere with mineral absorption and utilization which may affect the requirements [8]. Phytate has also been reported to interfere with the enzymatic process of protein digestion in the gut , [10].

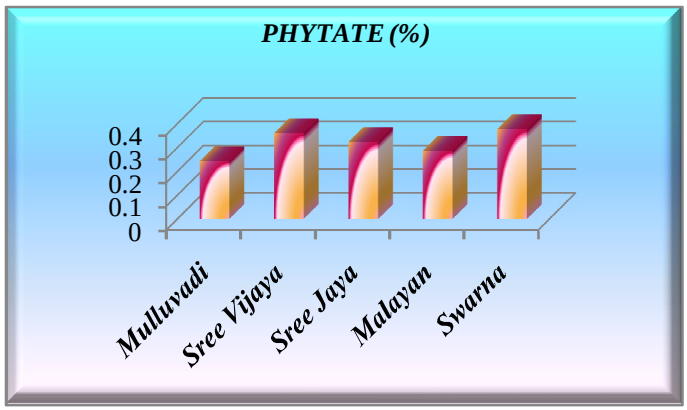

Figure: 2 - Results of phytate in the tubers of cassava

C) Total oxalate content

The total oxalate content in the five varieties of cassava tuber is shown in the Table: 1and in Figure: 3 Cassava tubers contains low amount of oxalate. The current study show that the oxalate content in each varieties is comparable to each other. The variety Swarna contains comparatively high amount of total oxalate (0.023±0.002 mg/g) when compared to others.The least amount was observed in Malayan tuber which is of 0.013±0.010 mg/g. The other varieties such as Mulluvadi, Sree Vijaya and Sree Jaya contains nearby amount of total oxalate which is, 0.015±0.02 mg/g, 0.017 ±0.003mg/g and 0.019±0.004mg/g. Various studies [5] have shown that the sweet cassava tuber contains 1.30±0.02 mg/100g of oxalate, and the bitter variety of 3.27±0.04 mg/100g of oxalate.

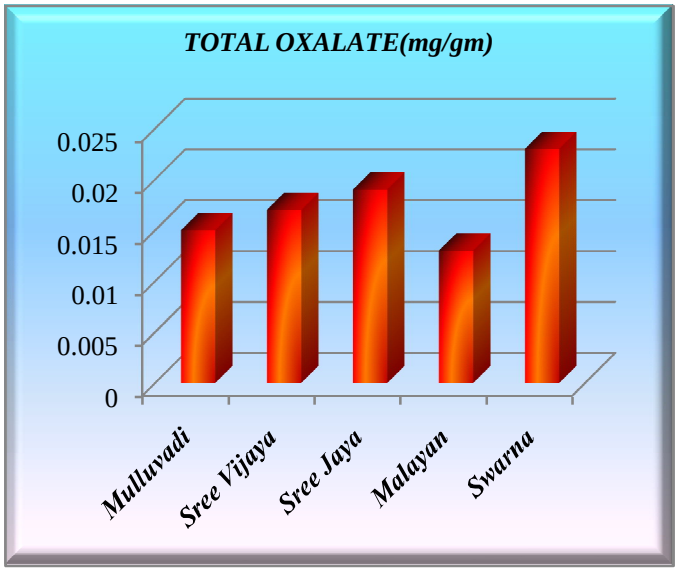

Figure: 3- Total Oxalate content in the cassava tubers

IV. CONCLUSION

Cassava (*Manihot esculenta* Crantz) tubers is widely used for consumption and it is also considered as one of the major staple food crop in many countries, because of their easy availability, low coast and their ability to withstand drought and low fertile soil. Even though they have the presence of carbohydrate, small quantity of anti-nutrients such as cyanide, tannin, phytate, oxalate etc.. is also present in the cassava tuber. Among these cyanide is an important toxic component present in it. Due to the presence of cyanide consuming raw cassava should be avoided.

The present study shows that among the selected five cassava tubers it is the tuber named Swarna which contains high amount of phytate and total oxalate, whereas the high amount of tannin is observed in Malayan. Only a slight difference in the amount of components were observed in all the taken varieties. Due to the presence of such anti-nutrients it is always advisable to consume the tuber only after adopting certain processing methods such as soaking, drying, fermentatation, cooking etc..

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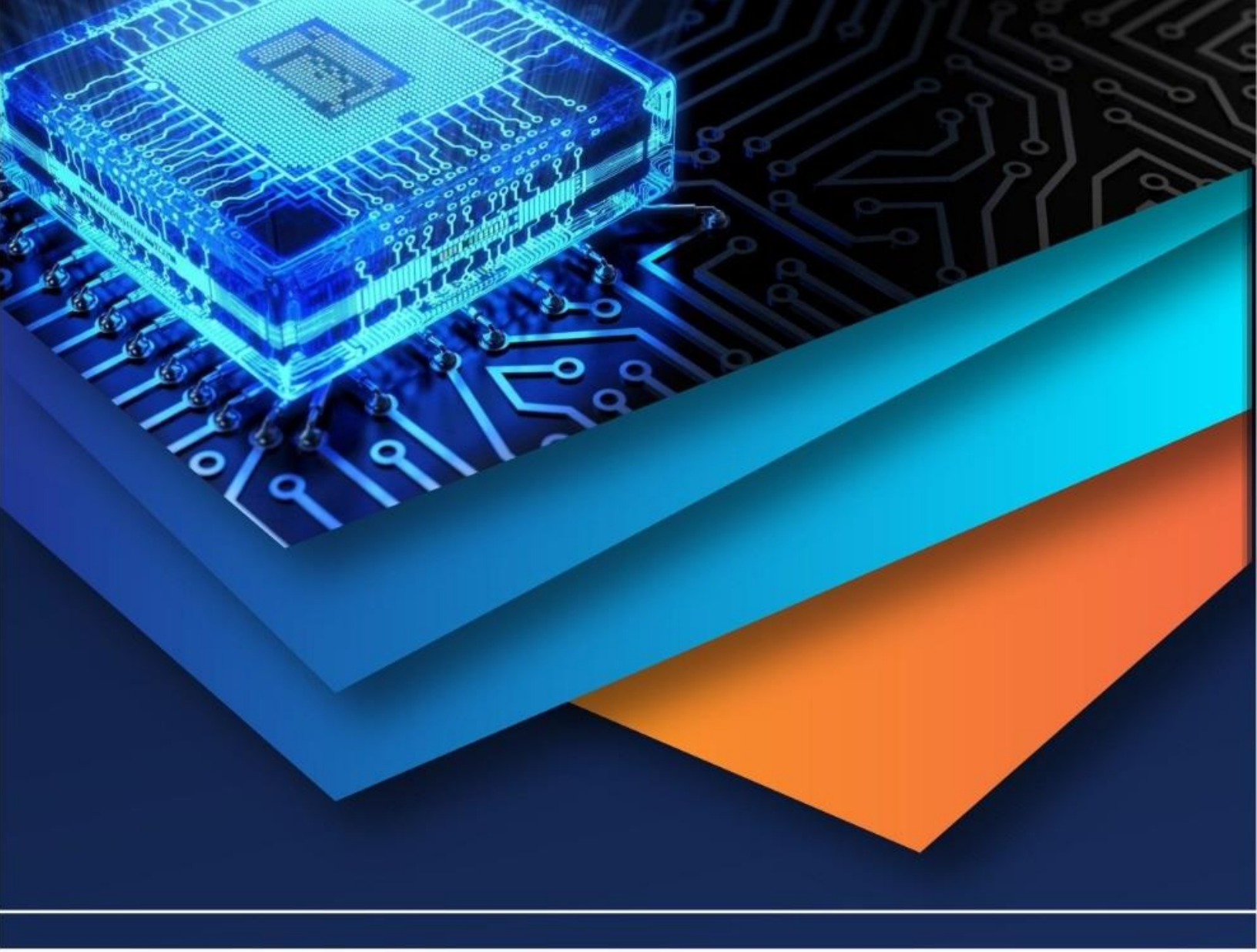

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