The Effect of Different Processing Method of *Manihot esculanta* on Cyanogenic Toxicity

M K D Poonima M Sathischandra*

Department of National Museums, University of Colombo, Colombo, Sri Lanka

Short Communication

Received: 04-Apr-2022, Manuscript No. JBS-22-57003; **Editor assigned:** 07-Apr-2022, Pre QC No. JBS-22-57003 (PQ); **Reviewed:** 22-Apr-2022, QC No. JBS-22-57003; **Revised:** 03-Jun-2022, Manuscript No. JBS-22-57003 (R); **Published:** 14-Jun-2022, DOI: 10.4172/2320-0189.11.6.008.

***For Correspondence:** J Mario Department of National Museums, University of Colombo, Colombo, Sri Lanka

E-mail: poornisathis5253@gmail.com

INTRODUCTION

Manihot esculanta, belongs to family *Euphorbiaceae* is used as a starchy food among the population mainly in subtropical and tropical areas which was introduced Sri Lanka in 1786. As cassava can tolerate in drought condition and grow in any type of soil, stressful environments under a range of climate conditions and pest attacks, cassava has become the major staple crop in many regions. In Sri Lanka Cassava is grown mainly for human consumption than the commercial expectations and leaves are consumed by the majority of the population in Sri Lanka, due to the higher availability and the lower production cost. After harvesting the cassava roots, it leaves cassava leaves as a byproduct, which does not make commercial competition [1].

This paper to review the current literature evidences on the use of cassava leaves as a nutrient source of the human; the efficient ways of processing method in the case of detoxification prior to having as a meal.

DESCRIPTION

Nutrient content of Cassava leaves

The cassava leaf meal has become a nutrient source, as cassava leaves consist with high amount of protein, carbohydrate, beta carotene, vitamin C, B_1, B_2, and other micro nutrients and macro nutrients as well. The mineral content of the cassava leaves are proving the potential use as human and animal feed [2].

The lush crop of cassava leaves is recorded the protein content within the range of 30%-40%, when it is expressed as the percentage of leaf dry matter [3]. Essential amino acids are also present in the range of the adequate amounts except Methionine, Lysine. However the amino acid content is favorable comparing with the animal protein and leguminous plant proteins [4]. The amino acid profile of the cassava leaves can full fill the protein requirement of the human and the recorded amount of the protein is higher for the non-legume plants and it is a fact to consider cassava is a solution for malnutrition. According to the literature, use of cassava leaves with different food pattern has been suggested as a fruitful solution to malnutrition among the population [5].

The levels of protein, beta carotene and vitamin C, and other nutrient content of the cassava leaves depend on the cultivar, part of the plant, harvesting period, soil fertility, age and the drying temperature. According the study done to determine the effect of the age of cassava leaves on the nutrient content, the leaves matured in age of 12 months reported the highest amount of crude protein levels with compared to 15 months and 17 months old (35.90 g/100 g of dry weight) [6]. The beta carotene highest amount (137.38 g/100 g) was reported by the sample with 12 months old. However, in the case of vitamin C the highest amount (181.90 g/100 g of dry weight) was recorded the leaves at the age of 17 months. The analysis revealed that the protein amount of the cassava leaves is changed at three different stages of the maturity. Crude protein and carbohydrate composition have been changed from higher to lower value percent dry weight, from the maturity level of the very young to mature leaves [7].

The protein content of the cassava leaves is decreased from 38.1% to 19.7% to from young to well mature leaves; in contrast, crude fiber level is increased when the maturity level of leaves is increased. The nutrient content of cassava is limited by the presence of high amount of anti-nutrients, fiber, cyanide, tannin and phytin in the leaves. The chemical composition of the cassava leaves also varies depending on the variety of cassava that assumed due to the genetic variations and the different development pattern of the plants [8].

Toxicity of cassava leaves

Cassava has cynogenic potential due to the presence of three types of cynogenes, linamarin, aceytohydrine and free cyanauric acid (HCN), where mainly linamarin. The enzymes which degrade cyanide into HCN present in cassava root and leaves in different concentrations. When the cells get damaged the linamerin and other cyanogenic compounds are exposed and the enzyme linamerase releases the cyanuric acid by degrading the cyanogenic glycosides [9].

Cyanuric acid is very toxic to human and main exposure to the toxicity can be ingestion or inhalation during the processing. According to the cyanuric acid content of the cassava three types of toxicity levels can be identified: Very toxic variety with more than 100 mg HCN/kg of pulp, moderately toxic variety with 50-100 mg HCN/kg of pulp and non- toxic variety with less than 50 mg HCN/kg of pulp [10]. WHO has recommended level of hydrogen cyanide-10 mgHCN/Kg body weight and intake of hydrogen cyanide exceeding this amount may cause the death [11].

Though the consumption of lower cyanide amount is not lethal, long term intake of cyanide could cause severe health effects on human [12]. Hence the consumption of non- detoxified cassava leaves and roots cause acute intoxication and the chronic health disorders such as goiter, dwarfism and the tropical ataxic nephropathy. Furthermore, literature revealed that the lethal consumption dose of cyanuric acid is 0.5 to 3.5 mg per kilogram body weight. A study reveals that the in-taking of cassava with cyanide concentration leads the Iodine deficiency disorders as thiyocyanate inhibits the Iodine uptake by the thyroid gland [13]. It is noteworthy that many countries have developed fermented cassava food products as an alternative for the cyanide toxicity of cassava [14].

The investigation conducted by Fayusi et al, using several varieties of cassava leaves, average amount of HCN was reported as 52.9 mgHCN/100 g. Moreover, average tannin composition reported as 9.7 Tannin/100 g, whereas the average phenol content is reported as 192.0 mgHCN/100 g. The studies have shown that the tannin and phytin content is higher than the other legumes and cereals mentioned in the literature [15].

Cyanide concentration present in the plants is associated with the age of the plant and several genes those involved in the cynogenesis pathway. Hence, these genetic differences of these genes affect the different cyanide concentrations in different varieties [16]. As fresh cassava leaves consist with higher amount of cyanide, literature has reported several effective methods to detoxify the cyanide toxicity mentioning that the traditional cooking methods of cassava leaves can limit the toxicity of cassava. Moreover, due to the fear of losing vitamins and other nutrients in cassava leaves, people are used to prepare the cassava leaves under mild heat treatments. This may cause severe health problems due to the ingestion of cyanide.

Processing methods of Cassava on detoxification

In Sri Lanka, people in rural areas under in drought condition, mostly consume cassava leaves for their meal. They are used to apply the traditional cooking methods which tempering the sliced leaves in 5 or 6 minutes. In this status, the bound cyanide content has been decreased only to the 540 $mgKg^{-1}$ fresh weight while resulting free cyanide to 119 $mgKg^{-1}$ fresh weights to a considerable amount and the amount is not within the safe limit. Further processing of the leaves in cooking by slicing, pounding and cooking for 2 hours leads to reduce the bound cyanide level to 5.9 $mgKg^{-1}$ fresh weight. And also similar lowering of the cyanide level has been reported with the leaves treated with boiling water. Fresh cassava leaves have reported 28.1 (% dry weight) of protein, whereas the boiling sample of the cassava leaves reported the 28.0 (% Dry weight). It is worthy to mention that the protein content of the cassava leaves was not affected by the boiling process [17].

Considering the traditional methods of cooking of Cassava leaves according to Fasuyi et al, 2005 cassava leaves subjected to different traditional processing methods, sun drying, oven drying, steaming and shredding. Sun drying with the shredding of cassava leaves showed the effective way on cyanogenic potential from 56.5 mgHCN/100 g in the fresh sample to 1.6-1.8 mgHCN/100 g while the oven drying was reported as the least effective for the cyanogenic detoxification [18]. For tannin and phytin the above methods of processing the cassava leaves are seem to be inefficient. However, for tannin and phytin the genetic reduction can be effective to reduce the effect of the tannin and phytin [19]. As further concluded in the study, the shredding with sun-drying of the cassava leaves can rupture the cells and bring out the linamerase enzyme allow the hydrolysis and resulted volatile HCN. In the case of oven drying of the cassava leaves, the enzymes get denatured with the effect of the higher temperature [20].

The boiling effect on the cyanogenic content of the cassava leaves also demonstrated in another study. The investigation is based on the altering the surface area of the leaves and pounding and soaking the leaves or combination of those two prior to cooking. The increasing of the boiling time from 10 minutes to 25 minutes reduces the cyanide level of the leaves. Furthermore, reduction of cyanogenic compounds in pounded leaves is higher than the unpounded leaves. This is due to the Area/Volume ratio of the unpounded leaves may inhibit the enzymatic reaction in contrast to the pounded leaves [21].

Pounding of leaves leads to the rupturing cells, stimulating the enzymatic reaction by direct contact with the substrate and the enzyme [22].

The use of traditional methods such as soaking, boiling, chipping, soaking, fermentation, cooking, steaming, drying and roasting, lead the enzyme linamerase to expose to the cyanogenic compounds and release free cyanide (HCN and cyanouric acid) and detoxification is occurred by dissolving HCN and escaping them into air [23]. Though the traditional processing methods can reduce the cyanide content to a certain level, it may not remove all the toxicity. But the genetic engineering has proven the greater potential to remove the cyanogenic toxicity [24,25].

CONCLUSION

Leaves of *Manihot esculanta* is a rich protein source as well as consist with carbohydrate, beta carotene, vitamin C, B_1, B_2, other micro and macro nutrient elements which is able to full fill the nutrient requirement of humans. Cultivar, part of the plant, harvesting period, soil fertility, age (maturity period) and the drying temperature determine the nutrient content of cassava leaves. The nutrient content of cassava is limited by the presence of high amount of anti-nutrients, fiber, cyanide, tannin and phytin in the leaves. The presence of cynogenic compound in cassava leaves results chronic and acute health disorders. According to the literature, different processing methods of cassava leaves can affect the cynogenic toxicity of cassava leaves than the prevailing traditional processing method of cassava.

REFERENCES

1. Bayata A, et al. Review on Nutritional value of Cassava for use as a staple food. Sci J Anal Chem. 2019;7:83-91.
2. Cooke RD, et al. (1979) Enzymatic assay for determining the cyanide content of cassava and cassava products. Cassava Information Center, Colombia.
3. Dissanayake UHK, et al. Characterization of Cassava (*Manihot esculanta*) Cultivars in Sri Lanka using Morphological, Molecular and Organoleptic Parameters. Trop Agric Res. 2018;30:51-70.
4. Eggum OB, et al. The protein quality of cassava leavess. Br J Nutr. 1970;24:2761-769.
5. Fukushima AR, et al. Cassava flour: quantification of cyanide content. Food Nutr Sci. 2016;7:592-599.
6. Fasuyi AO, et al. Nutrient composition and processing effects on Cassava leaf (*Manihot esculenta,* Crantz) antinutrients. Pak J Nutr. 2005;4:37-42.
7. Jansz ER, et al. Biochemical aspects of Cassava (*Manihot esculanta*) with special emphasis on cyanogenic glucosides. J Natl Sci Found Sri Lanka. 1997;25:1-24.
8. Kobawila SC, et al. Reduction of the cyanide content during fermentation of cassava roots and leaves to produce bikedi and ntoba mbodi, two food products from Congo. Afr J Biotechnol. 2005;4:689-696.
9. Morgan KT, et al. Cassava: nutrient composition and nutritive value in poultry diets. Anim Nutr. 2016; 2:253-261.
10. Moriasi GA, et al. Evaluation of cyanide levels in two cassava varities (Mariwa and Nyakatanegi) Grown in Bar - agulu, Siaya County, Kenya. J Food Nutr Res. 2017;5:817-823.
11. Muleta F, et al. Determination of cyanide concentration levels in different cassava varieties in selected iodine deficiency disordered areas of Wolaita Zone, Southern Ethiopia. J Nat Sci Res. 2017;7:29-38.
12. Obeten KE, et al. Effect of aqueous extract of cassava (*manihot esulenta*) leaf on the morphology and micro-anatomy of the liverof wister rats. Int J Anat Res. 2017;5:4031-4035
13. Ojimbo OC, et al. Reduction of cyanide levels in sweet cassava leaves grown in Busia County, Kenya based on different processing methods. Food Res. 2017;1:97-102.
14. Oresegun AOA, et al. Nutritional and anti-nutritional composition of cassava leaf protein concentrate from six cassava varieties for use in aqua feed. Cogent food agric. 2016;2
15. Piero NM, et al. Determination of cyanogenic compounds content in transgenic acyanogenic kenyan Cassava (*Manihot esculenta* Crantz) genotypes: linking molecular analysis to biochemical analysis. J Anal Bio-anal. 2016;6:264-271.
16. Priyadarshani AMB, et al. Detoxification of Cassava leaves. J Natl Sci Found. 2004;32:61-68.
17. Ravindran G, et al. Changes in the nutritional composition of Cassava (*Manihot esculanta*) leaves during maturuty. Food Chem. 1988;27:299-309.
18. Salvador EM, et al. Production, Consumption and nutritional value of cassava in Mozambique. J Agric Biotech Sustain Dev. 1988;6:9-38.
19. Shama AYI, et al. Evaluation of the toxicity of *Manihot esculanta* on Wistar rats after traditional sudanese processing. J Pharmacol Toxicol. 2011;6:418-426.
20. Somendrika MAD, et al. Proximate composition of the flesh and the peel of Sri Lankan Cassava variety “MU-51”. Int J Food Sci. 2017;4:267-270.
21. Somendrika MAD, et al. Nutritional composition of Cassava Cultivar "CARI 555”. Pak J Nutr. 2017;16:216-220.
22. Tivana LD, et al. Straightforward rapid spectrophotometric quantification of total cyanogenic glycosides in fresh and processed cassava products. Food Chem. 2014;20-47.
23. Wargiono, et al. Contribution of cassava used as a vegetable to improve human nutrition in Indonesia. 466-472.
24. Wobeto C, et al. Nutrients in the Cassava (*Manihot esculanta*) leaf meal at three ages of the plant. Food Sci Technol. 2006;26:865-86.

25. Zekarias T, et al. Medicinal, nutritional and anti-nutritional properties of Cassava. J Nutr. 2019;8:34-46.