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Physiological Deterioration of Cassava Tuber

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ABSTRACT

The present study was carried out to evaluate cassava genotypes for Postharvest Physiological Deterioration (PPD). Tubers from different genotypes were evaluated at 1,2,3,4 and 5 days after harvest for PPD. Two genotypes *viz.,* CI 850 and YTP 1 showed their supremacy in recording low levels of PPD (9.81 and 11.76 % respectively) even five days after harvest. This could be the result of lower cyanide (HCN) content. Starch content was decreased at storage. This study can be used to understand the mechanisms of PPD in cassava tubers.

Key words : *Postharvest Physiological Deterioration, Cyanide, Starch, Image analyzer*

Introduction

Cassava *(Manihot esculenta*, Crantz) is an annual tuber crop grow widely in tropical and sub tropical areas. Cassava has an efficient use of water, soil nutrients and tolerance to abiotic stress and sporadic pest attacks and it can produce reasonable yields in areas with poor soils and unpredictable rainfall. The tubers of cassava are rich in starch, which makes them an important source of energy dietary. Its starch content ranges from 20 to 40% based on fresh weight and at about 80.6% based on dry weight with 38.6% total dry matter. Cassava tuber market price is fixed based on the starch content. The short shelf life of the tuber limits cassava's economic and industrial probable. Even though cassava has been already identified as a superior and high productive crop for future climate change condition, Postharvest Physiological Deterioration (PPD) is the major problem due to its short shelf life. So, during the period of higher demand and supply to the market, storage becomes the major problem in cassava tuber. PPD in cassava tuber is rapid, begins within 24 hrs after harvest and can result in losses in the range of 40 – 65 per cent of the total expected economic value of the cassava. This study highlights to identify the tolerant cassava genotypes for PPD based on physiological evaluations.

Methods

Plant material

Cassava genotypes collected from the Tapioca and Castor Research Station, Yethapur, Tamil Nadu, India. Cassava tubers from twelve month old plants were harvested by digging the rhizosphere area and carefully removed the roots from the soil to avoiding any wounding.

Determination of total cyanide content

Total hydrogen cyanide (HCN) content of tuber was estimated by the method of Indian Standard, IS : 4706 - 1978 Part II, Test for presence of hydrocyanic acid in cassava tubers and expressed as ppm.

Determination of Starch (Acid Hydrolysis Method)

Starch content of tuber was estimated by the method of Indian Standard, IS : 4706 - 1978 Part II, Methods

of test for edible starches and starch products and expressed as mg g^{-1} fresh weight.

PPD evaluation

After 24 h of storage, 25, 50 and 75 per cent of the total length (Plate 6) from each tuber were cut as transverse sections starting from the proximal end. A slice of tuber (0.3 cm average thickness) was cut transversely (2 cm) every day, up to 5 days and used for PPD evaluation. Digital images for each tuber slice were taken using image analyzer (WinDIAS 3.2, A3LIGHTBOH, made in Vietnam) (Plate 5,6) and PPD for each tuber slice was assigned according to the following equation and expressed in per cent.

$$\text{PPD}(\%) = \frac{\text{Total area of sliced tuber} - \text{Non deteriorated area}}{\text{Total area of sliced tuber}} \times 100$$

Percentage of PPD for each cassava genotypes was obtained by averaging each independent PPD percentage from biological replicates.

Results and Discussion

Cassava roots have a short shelf life due to postharvest physiological deterioration (PPD). In this study the percentage of PPD was evaluated by a methodology based on between the total area of transverse cross section to infected area by using image analyzer. A wide range of PPD (%) was observed in different cassava genotypes at first day to fifth day. Higher level of PPD was recorded in the genotype H226 as 21.98, 26.85, 32.17, 54.98 and 71.72 (%) in day one to five after harvest respectively. CI-850 had significantly lower percentage of PPD during first day to fifth day of storage period. Salcedo *et al.* (2010) obtained similar results in different genotype behaviors for PPD tolerance. Due to the high perishability of cassava root, caused by PPD, the economic losses are inevitable, negatively impacting the supply of roots as a raw material for fresh or industrial consumption (Reilly *et al.*, 2004). It is estimated that, world postharvest losses in cassava is 15 – 30 % (FAO, 200), and losses due to PPD range from 5-30 % of harvested roots (Zidenga *et al.*, 2012). Postharvest physiological deterioration begins with vascular streaking, which is a blue-black discoloration of the xylem parenchyma, followed by general discoloration in cassava tuber

The World Health Organisation has set the safe level of hydrogen cyanogens in cassava flour at 10 ppm (FAO/WHO, 1991). H226 had a cyanide content of 176 ppm at 3DAH, which is poisonous and unsafe for consumption. The low level of HCN was recorded in CI-850 (9.45 ppm). Reilly *et al.* (2004) reported that, bitter taste of cassava is due to high cyanide in parenchyma of roots and gradually in-

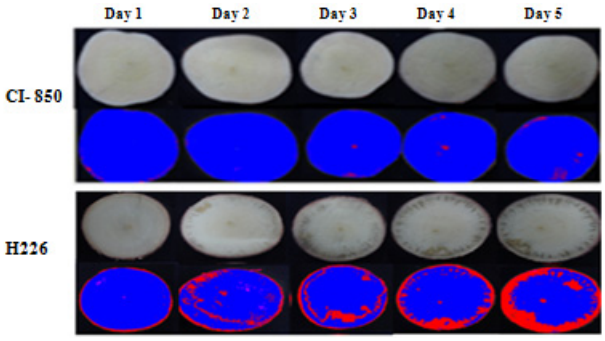

Fig. 2. PPD infected area in cassava tuber at storage (Blue colour indicates non deteriorated area and red colour indicates deteriorated area)

Table 1. Starch and HCN content of cassava tuber at storage

Genotypes	Day 1	Day 2	Day 3	Day 4	Day 5	Mean
			Starch content (% fresh weight)			
CI 850	24.56	23.21	22.18	21.87	21.17	22.59
YTP 1	27.78	25.17	23.78	22.62	21.66	24.20
H226	28.94	20.21	16.54	14.38	11.78	18.37
H740/92	25.18	24.44	23.58	21.98	20.87	23.21
Mean	26.62	23.26	21.52	20.21	18.87	22.09
			HCN content (ppm)			
CI 850	3.59	7.89	9.45	10.87	12.54	8.868
YTP 1	4.01	8.43	10.47	15.67	17.99	11.31
H226	23.87	76.78	176.72	221.58	483.67	196.52
H740/92	6.81	8.21	10.69	17.81	22.67	13.23
Mean	9.57	25.33	51.84	66.48	134.22	57.49

creased after harvest. The H226 is highly sensitive to PPD, but resistant to microbial deterioration. The present study reveal that starch hydrolysis gradually increased in H226, but in CI-850 and YTP-1 starch degradation percentage is very low compared to other genotypes. Biochemical changes during PPD include increases in respiration (Sánchez *et al*., 2013), mobilisation of starch to sugars and changes in lipid composition (Lalaguna and Agudo, 1989). Evaluation of PPD in cassava tuber is a key step leading to a better understanding of events taking place during PPD and subsequently, the identification of genotypes with delayed PPD.

Conclusion

The present study evaluated the severity of the postharvest physiological deterioration in cassava tubers. The major constraint facing the large scale production and marketing of fresh cassava tubers is the rapid postharvest deterioration. PPD is the challenging factor for cassava growers and processors. This study pave the way for understanding the mechanisms behind this and gives practical solution for farmers to lengthen the shelf life of the tubers by delaying the onset of PPD.

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