

Changes in Amylase Activity Starch and Sugars Contents in Mango Fruits Pulp Cv. Tommy Atkins With Spongy Tissue

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ABSTRACT

Changes in amylase activity, starch and reducing and non-reducing sugars contents were monitored during ripening of mango fruits (*Mangifera indica* L.). The climateric raising in mango fruit is marked by an appreciable increase in the activity of amylase, reducing and non-reducing sugars contents and decrease in the starch content. The fruit affected with spongy tissue exhibited much lower amylase activity and reducing and non-reducing sugars, but exhibited much higher starch content during storage at $12 \pm 2^{\circ}\text{C}$ and $90 \pm 5\%$ RH for 28 days, when compared to healthy tissue of 'Tommy Atkins'. Whether this is caused due to adverse effects on certain enzyme activities during ripening is not clearly known. These dates showed that carbohydrate metabolism is an important feature during ripening of mango.

Key words: Starch, amylase, reducing sugars, non-reducing sugars

INTRODUCTION

The climateric rise in mango fruit is marked by an appreciable incresase in the activity of several enzymes. However, this fruit is susceptible to internal physiological disorders that cause appreciable losses to producers: The term "physiological disorders" in mango is used for various internal flesh breakdowns (soft nose, jelly seed and spongy tissue), show many similarities (Wainwright and Burbage, 1989). The affected flesh tissue can be distinguished from the outer portion others by unattractive flavour. The texture is soft, spongy or leathery depending on the severith of the damage. The occurrence and intensity of the disorders depend upon many factors, mainly those related to climate, location, and cultivars (Raymond et al., 1998; Chitarra et

al., 1999; Burdon et al., 1991). The symptoms are manifested at the final stage of fruit growth and maturation (Lima, et al., 1999; Thomas, et al., 1993).

Chemical and biochemical studies showed many compositional and metabolic differences between the healthy and the damaged tissue (Raymond et al., 1998; Lima, et al., 1999; Gupta, 1985). However, only limited information is available on certain enzyme activities during hydrolysis of starch in tissue damaged with internal breakdown during ripening.

Amylase activity has been reported in mangoes to increase when the fruits growth afterwards and to decreases towards maturity (Sen et al., 1985). In damaged tissue it was about three times lower as compared to healthy pulp from healthy fruit and healthy pulp from spongy tissue (Katrodia 1988).

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The low activity of amylase resulted in retention of starch in the affected tissue.

The aim of this research was to investigate changes in carbohydrate metabolism, of mango fruits affected with spongy tissue in relation to healthy tissue.

MATERIAL AND METHODS

Plant materials: Mango fruits, cv. Tommy Atkins, were harvested at physiological maturity (shoulder formation) in commercial orchards from Assu-Valley-RN-Brazil.

Internal flesh breakdown in fruit was assessed by X-ray photographs, using a Salgado Herman X-ray 300 mA machine operated at 30 KV, 4 mA.s⁻¹ used for medical diagnostic purposes. Healthy and damaged fruits were separated in three groups: Half healthy fruits, F₁; Half healthy of the fruits with physiological ripening spongy tissue, F₂; and half of the fruit with disorder, F₃, and stored at 12 ± 2°C and 85 ± 3 % RH for 28 days. Analyses of healthy and damaged tissues were made in fruits at 7-day intervals, using 5 fruits per treatment with with 4 replicates.

Enzyme extraction Enzyme extraction, was done according to the method proposed by Gupta et al., (1985).

Amylase activity assay Amylase activity was determined by measuring the reducing sugars released from soluble starch Nelson (1944) as modified by Somogyi (1952). The reaction mixture containing 0,5 mL of crude enzyme, 0,5 mL of 1% soluble starch pH 7,0 incubated at 37 C for 60 min. After this time the reaction was stopped by addition of 1 mL of 2N NaOH. The amount of reducing sugars released were colorimetrically determined. A calibration curve was obtained using D-glucose as standard.

Reducing and non-reducing sugars Five grams of pulp from each group were homogenized in 50 mL distilled water with 0,5 mL of 0,5 N of NaOH at room temperature in a tissue homogenizer and then neutralized with 0,5 N of acetic acid, homogenized, final volume was made 100 mL

with distilled water, stirred and filtrated. Five mL of the filtrate were mixed with 20 mL of 85% ethanol. The slurry was centrifuged for 20 min at 25000 G at 4 °C. The supernatant I was removed. The solids were treated simillarty and all the supernatants were combined extract was repeated for two times.

The combined extract was evapored in water bath at 65 °C to 5 mL. The residue was washed with distilled water. The resulting extract was used for the assay of reducing and non-reducing sugar. The amount of reducing and non-reducing sugars was calculated from the standard curve of D-glucose.

Starch determination The residue obtained was resuspended with amilogucosidase solution of the 14U/mL in 0,1N sodium acetate buffer, pH 4,8 for 2 hr at 40 °C. At this period, reaction was stopped by adding 1 mL of 0,6 N percloric acid. The reducing sugars producted were determined from the standard curve of D-glucose.

RESULTS AND DISCUSSION

Starch is the main carbohydrate present in mature green mango fruit (Subramanyam et al., 1976; Mattoo et al., 1975). During mango ripening, starch is hydrolyzed. It appears that in fruit F₁, during the first week harvest, in order to complete the hydrolysis increase. However, as the fruit becomes over-ripe, only traces of starch can be detected; amylase activity was also substancially reduced, (Fig 1). The sugars in the pulp spongy tissue be accounted for by the presence of higher than content of starch in the affected pulp, which remained unhydrolysed due the low activity of amylase during ripening.

Appreciable reduction of reducing and non-reducing sugars were observed in the damaged fruits and, unaffected part of spongy tissue of ripe fruits as compared to healthy ones. Similar findings were observed by Subramanyam et al., (1971), Katrodia, (1988).

The contents of reducing sugar in and non-reducing in spongy tissue may be also attributed to lower activities of invertase and amylase. These

data showed that amylolytic activity was an important feature during mango ripening; however, its exact nature is unknown in spongy tissue.

The occurrence of spongy tissue have seriously affected the potential for marketing mango fruits if care is not taken during fruit harvest and grading the fruits before transportation. There is considerable scope for more research into the factors in molecular level, which predispose fruit to the development of the disorder. In the

short term it be productive to examine intermediary glycolytic pathway to reduce the disorder incidence.

A long term solution is to develop cultivars with less susceptibility to the disorder, or to improve the commercial value of low susceptibility genotypes. However, it is clear that to obtain a commercially successful, any new cultivar will have to match both the organoleptic and storage qualities, as well as yield and cropping characteristics, in comparison to those cultivars which are grown commercially.

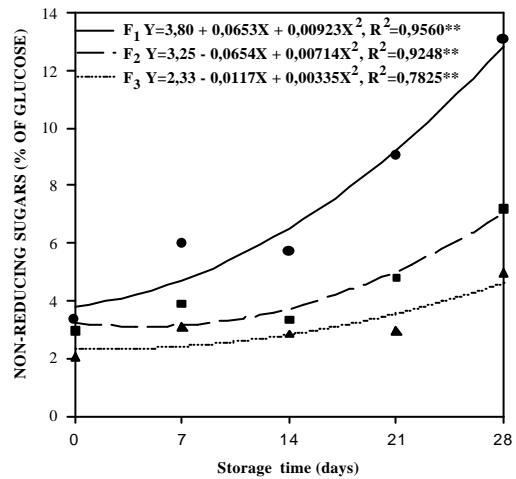
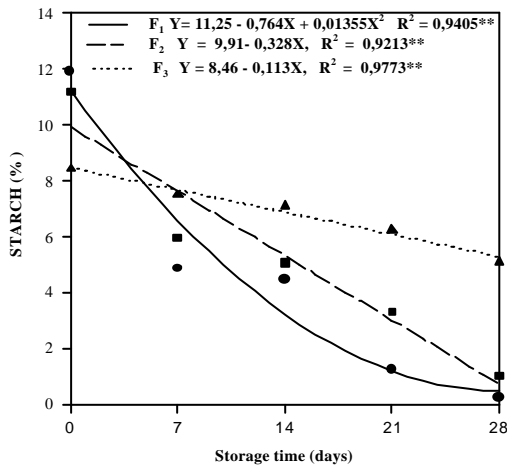
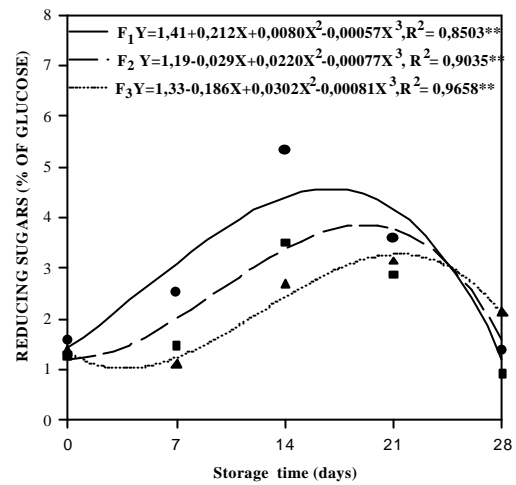
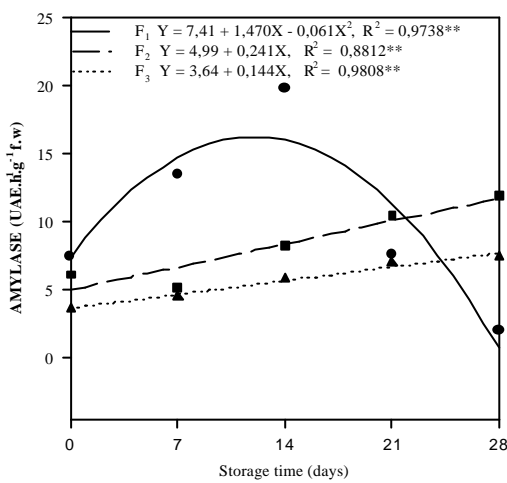


Figure 1 - Amylase activity and starch content of the pulp of mango ‘Tommy Atkins’ stored during 28 days under temperature of 12 ± 2 °C and relative humidity of 90 ± 5 % in 4 day of maturation. Half healthy fruits F₁; and half healthy of the fruit with physiological ripening (spongy tissue), F₂; and half of the fruit with disorder, F₃.

Figure 2 - Reducing and non-reducing sugars, of the pulp of mango ‘Tommy Atkins’ stored during 28 days under temperature of 12 ± 2 °C and relative humidity of 90 ± 5 % in 4 day of maturation. Half healthy fruits F₁; and half healthy of the fruit with physiological ripening (spongy tissue), F₂; and half of the fruit with disorder, F₃.

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RESUMO

Mudanças na atividade amilase, conteúdo de amido e açúcares redutores e não redutores foram monitorados durante o amadurecimento de mangas (*Mangifera indica* L.). A elevação climática em mangas é marcada por apreciável aumento na atividade de amilases, aumento do conteúdo de açúcares redutores e não redutores e um decréscimo no conteúdo de amido. Os frutos afetados com tecido esponjoso exibiu atividade desta enzima muito mais baixa e conteúdo de açúcares redutores e não redutores, mas exibiu conteúdo muito mais elevado de amido durante o armazenamento em 12 ± 2 °C e 90 ± 5 % de umidade relativa por 28 dias, comparado ao fruto sadio de "Tommy Atkins". Se isto é causado devido a fatores adversos sob a atividade de certas enzimas durante o amadurecimento isto não é claramente conhecido. Estes dados mostram que o metabolismo de carboidratos é um importante aspecto durante o amadurecimento de mangas.

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