A study of pineapple black heart disorder: Measures to reduce postharvest losses during transportation and storage

D.S. Pitadeniya* and P.L.N. Lakshman
Department of Agric Chemistry, Faculty of Agriculture, University of Ruhuna, Kamburupitiya, Sri Lanka.

Abstract

Since 1983, export of fresh pineapple fruits to Middle East countries has considerably reduced as consignments of these fruits have been subjected to a physiological disorder, resulting in core breakdown and Internal Browning (IB) under cold storage conditions. The purpose of this study was to examine the best method of controlling IB. Experiment was conducted in two stages. In the first stage, eight treatments involving chemical, physical and physico-chemical methods were tested with four replicates. Fruits were stored in the cold room (+10 °C, and 85 % RH) and samples were taken at day 12, 14, 16, 18, 20 and 22 of storage period. They were kept for one day at room temperature 28.9 °C (RH 97 %). Fruits wrapped in cellophane sheets and coated with 5 % wax solution with postharvest fungicide (Benlate (1 g/l)) were selected for the second stage. The same treatments were applied with slight modifications. Wrapping of cellophane sheet around the fruit prevented IB up to 18 d. Application of wax around the fruit was selected as the most effective treatment which reduced IB induction by 87.5 %, while control showed 100 % induction at day 20.

Keywords: Internal browning, pineapple, black heart disorder, physico-chemical method, wax coating

Introduction

Pineapple is a popular fresh fruit, which has a high demand in the local and export market. However, in developing countries, postharvest losses associated with pineapple could be as high as 70 % of shipments. The first symptom of endogenous brown rot is the appearance of a small translucent spot in the flesh of the fruit, close to the central cylinder, approximately 2 cm below the base of the crown. Symptoms may develop within 4 d of ambient temperature following refrigeration at common commercial shipping temperature of 10 °C. The affected area enlarges, and only a narrow band of the flesh between the peel and rotted tissue remains healthy. Despite the internal alterations, no symptoms are observed externally and infected fruits look healthy. Pineapple growers as well as exporters in Sri Lanka face heavy economic losses due to IB and to-date no permanent solution has been found. The objectives of this study were to find out the root cause of IB in pineapple and to compare the effectiveness of physical, chemical and physico-chemical treatments for extending storage period and reduce IB induction.

Materials and Methods

Fresh pineapple fruits harvested from Gampaha area at mature stage, 100 % green stage (Teisson, 1975 and Adikaram, 2001) were immediately transported to Expo Lanka Limited. Variety *Kew* was selected for the experiments due to its high resistance to IB and it has a better commercial value (Adikaram, 2001). They were kept in a shady place, brushed and trimmed the stalk to maintain 1-1.5 " length. Then stalks were dipped in fungicide Benomyl (0.5 g/l) or Benlate (1 g/l) for 5 min.

Nine treatments were tested with 4 replicates, as follows.

T_1- Pineapples wrapped in polyethylene (75 μm) with crown and sealed with rubber bands.

T_2- Six pineapples wrapped together using polyethylene (75 μm) and sealed with rubber bands.
T_3- Cut surface of the stalks were dipped in 20 % Benzoic acid in Methyl alcohol solution for 5 min.
T_4- Fruits were subjected to modified atmosphere condition. Brick pieces soaked in saturated $KMnO_4$ solution and kept in polyethylene bags.
T_5- Pineapples coated with 5 % wax solution with Benomyl.
T_6- Cut surface of the stalk dipped in 8 % K_2SO_4 solution and left for 5 min.
T_7- Cut surface of the stalk dipped in 20 % Benzoic acid solution in Ethyl alcohol and kept for 5 min.
T_8- Pineapples wrapped with Cellophane sheets without covering crown leaves.
T_9- Control.

Treated pineapples were packed separately in well-ventilated corrugated fiberboard carton boxes. Boxes were kept at +10 °C and 85 % RH. Cut surface of each treatment was observed on day12, 14, 16, 18, 20 and 22. Data were recorded according to visual appearance on core and flesh discoloration. Data were analyzed by Friedman Multiple Comparison Test.

Table 1. Score description of measuring IB

Score	Description
0	No sign of Browning
1	Watery spots near the stalk end of core
2	10 % pineapple flesh covered with internal browning tissues, spots are enclosed
3	25 % pineapple flesh covered with internal browning tissues
4	50 % pineapple flesh covered with internal browning tissues
5	75 % pineapple flesh covered with internal browning tissues
6	100 % or complete cover of pineapple flesh from internal browning tissues

(Source: Teisson, 1975)

Results and Discussion

First stage

On day 12 after storage, initial symptoms of core deterioration were observed with the formation of translucent tissues in the core and basal parts. However, intensity of damage increased with the storage period, particularly after 3 weeks of cold storage. Application of wax solution and wrapping with cellophane sheet, showed least symptoms even 22 d of storage period. Application of benzoic acid with alcohol was not effective as shown in literature. Supplying K^+ ions to the fruit pulp showed a decline of IB, but not able to control IB for 18 d. Wegarathnam *et al*, (2003) stated that Ca^{2+} and K^+ concentration of the flesh reduces IB extraordinarily. Ca^{2+} and K^+ ions are easily applied with fertilizers.

Limitations

Cold room temperature was not regulated throughout the experimental period. Temperature and relative humidity fluctuated (Temperature: 9.5 °C - 15.5 °C and RH: 85 % - 90 %) even under controlled cold room conditions. Until day 18, treatments were not significantly different from each other. However, IB was observed even on day 12.

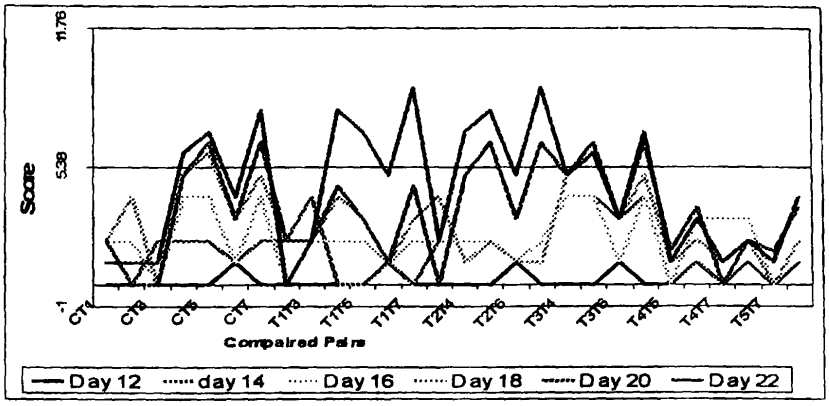

Fig. 1: Compared means by friedman test

- According to the graph, coated with 5 % wax solution and wrapped with Cellophane sheets were the best treatments.

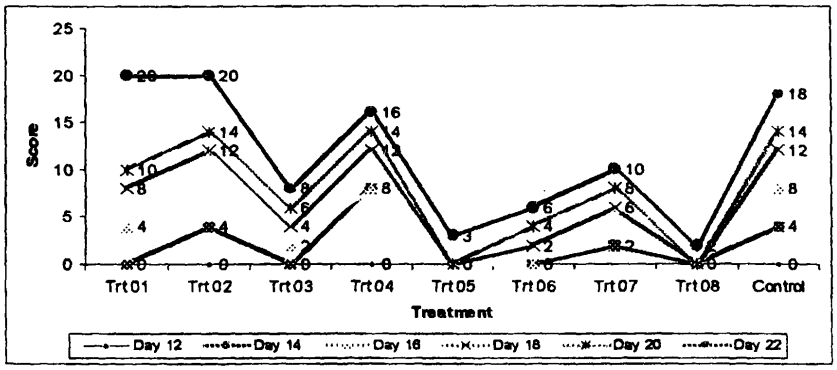

Fig. 2: IB development during the storage period

At treatment 5 (coated with 5 % wax solution) showed a remarkable IB reduction until day 20.

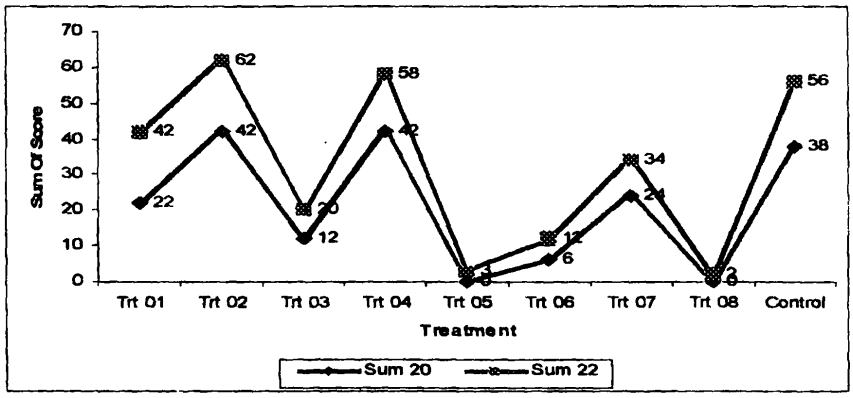

Fig. 3: Total rank values at 20 and 22 d of storage

Second stage

On day 20, treatments no 5 and 7 were significant at á 0.01 %. Losses due to IB were greatly increased with storage period. Considering transportation of pineapple to Middle East countries, maintaining postharvest qualities for 20 d is a great achievement. Therefore, day 20 was considered as the deadline for the second stage of treatment application. Wrapping of cellophane sheet around the fruit can prevent IB up

to 18 d. However, application of wax around the fruit was selected as the most effective treatment to reduce IB induction. It reduced IB induction by 87.5 % while control showed 100 % induction. This may be due to creation of modified atmosphere within the fruit and reduction of moisture losses from the fruit. Wax coating may be reduced Ethylene production and senescence of pineapple fruit (Sarananda *et, al.*, 1996).

Conclusions

Deterioration parameters including IB were pronounced with the prolonged storage periods. A remarkable IB reduction in fruits wrapped with Cellophane was observed on day 18. Wax formulation showed a significantly (á = 0.01) lower IB induction even at day 22. Application of wax around the fruit was the most effective treatment which reduced IB induction by 87.5 % on day 20, whereas it was 100 % in the control. However, losses due to IB were approximately 12.5 % in wax treated pineapples. It was a great reduction of the disease incidence when compared with treatments that have been proposed by previous researchers. Pineapples do not ripe as long as they are stored in the cold room. As soon as they are taken out from the cold room, ripening takes place rapidly (within 2 d).

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