

## Effect of Pineapple Shell Extracts on Browning in Fresh Vegetable and Fruit Puree and Slices

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### ABSTRACT

The effects of pineapple shell extract (PSE) on browning in banana, potato, mushroom and apple puree and slices compared with citric acid solution (pH 3.8) (PH) and distilled water (DW) were investigated by measuring the changes in color and browning values. The browning values of banana puree treated with PSE and PH were not significantly different. They had lower browning values than that treated with DW after storage for 1 hour ( $p \leq 0.05$ ). The browning values of banana puree treated with PSE, PH and DW were 2.95, 3.04 and 4.27, respectively. The browning value of potato puree treated with PSE was lower than those treated with PH and DW. Mushroom and apple puree treated with PSE had higher browning values than those treated with PH and DW. On the contrary, banana slices treated with PSE had a lower browning value than those treated with PH and DW during storage for 2 hours. The browning values of banana slices treated with PSE, PH and DW were 2.00, 3.10 and 5.80, respectively ( $p \leq 0.05$ ). Potato, mushroom and apple slices treated with PSE had browning values similar to those treated with PH and DW. Therefore, the increase in browning in banana treated with PSE seemed to be less than those of potato, mushroom and apple during storage.

**Key words:** enzymatic browning, polyphenol oxidase, pineapple shell extracts

### INTRODUCTION

Browning, a major problem in the quality loss of fresh vegetables and fruits, is the result of enzymatic reaction of polyphenol oxidase (PPO), which can deteriorate flavor, nutritional qualities and consumer's acceptance (Severini *et al.*, 2003). The most widespread agents used to control browning are sulfiting agents. Due to adverse health effects (Saper, 1993), several studies have been carried out to find natural extracts able to reduce browning eg papain from papaya which could reduce browning similar to sulfite

compounds (Labuza *et al.*, 1990). Browning reaction in apple and grape juice was decreased when treated with phenolic extracts from honey (Ozsmianski and Lee, 1990). Phenolic extracts from fig latex, anisaldehyde of anise seed could reduce browning as well (McEvily *et al.*, 1992; Kubo and Kinst-Hori, 1998). Oxalic acid in rhubarb juice could inhibit browning of apple slices (Son *et al.*, 2000). Onion extract could prevent browning of pear (Kim *et al.*, 2005). Moreover, Lozano-de-Gonzalez *et al.*, (1993) found that pineapple juice could reduce browning in apple slices. However, pineapple shell had not

been reported for the effectiveness in reduction of browning in fresh vegetables and fruits. Larrauri *et al.* (1997) also reported that pineapple shell is a source of phenolic compounds such as polyphenols, flavonoids, carotenoids that showed antioxidant activity and may involve in browning inhibition. Moreover, pineapple shell is the major waste from pineapple processing industry and can be used as raw material in production of natural browning inhibitor, for value adding. Therefore, in this research, the effect of pineapple shell extract on browning of fresh vegetable and fruit puree and slices was investigated and compared with citric acid solution and distilled water.

## MATERIALS AND METHODS

### Preparation of pineapple shell extracts (PSE)

The shells of pineapple at ripening stage 4 were obtained from Dole Thailand Ltd. It was blended in liquid N<sub>2</sub>, then extracted with distilled water at 1:2 (w/w) by using magnetic stirrer for 20 min and filtered with Whatman paper filter No.4. The supernatant was pineapple shell extract (PSE) used in this study.

### Fresh vegetable and fruit puree preparation and treatment

Bananas, potatoes, mushrooms and apples were peeled and blended with PSE, citric acid solution (pH 3.8) and distilled water at ratio of 1:1 (w/w) for 20 s, then stored at 5°C for 24 hrs. The color values (L\*, a\* and b\*) of the samples were measured with Spectrophotometer CM 2002, Minolta at 0, 0.5, 1, 2, 3, 6, 12 and 24 hr(s) during storage and the browning values ( $(\Delta L^*/L_o^*) \times 100$ ) were calculated; when  $\Delta L^*$  is equal to  $L_o^* - L^*$ ; L\* is the L\* value at any time and L<sub>o</sub>\* is the initial L\* measurement (Labuza *et al.* 1990).

### Fresh vegetable and fruit slice preparation and treatment

Bananas were peeled and sliced across

at the thickness of 0.5 cm. The slice samples were soaked in PSE and citric acid solution (pH 3.8) or distilled water for 5 min at room temperature. The excess liquid was drained, and then the slice samples were stored at 5°C for 24 hrs. The color values (L\*, a\* and b\*) were evaluated at 0, 0.5, 1, 2, 3, 6, 12 and 24 hr(s) during storage and the browning values were calculated as described above.

### Statistical analysis

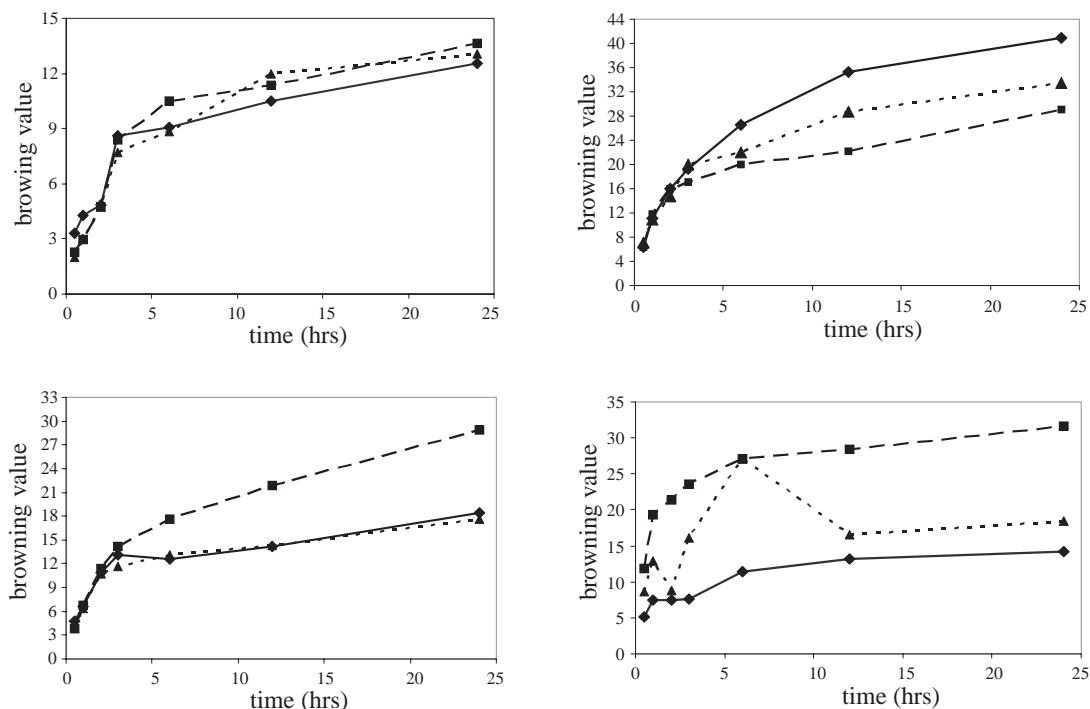
The experiment was performed in three replications with three repeated measurements in each replication. The SPSS statistical analysis system was used for analysis of the data. Statistically significant difference was assessed by one-way analysis of variance. Significant difference ( $p \leq 0.05$ ) among various treatments was detected by using Duncan's multiple range tests.

## RESULTS AND DISCUSSIONS

### Effect of pineapple shell extracts on browning of vegetable and fruit puree

Browning values of banana, potato, mushroom and apple blended with pineapple shell extract (PSE) citric acid solution (pH 3.8) (PH) and distilled water (DW) and stored at 5°C for 24 hrs are shown in Figure1. After storage for 1 hr, banana puree treated with PSE had slightly lower browning values than that treated with PH but it had lower browning value than that treated with DW ( $p \leq 0.05$ ). Browning values of banana puree treated with PSE, PH and DW were 2.95, 3.04 and 4.27, respectively. This indicated that PSE could reduce browning value in banana puree as effective as PH and more effective than DW. However, their browning values were similar at 24 hr storage.

Potato puree treated with PSE did not show significantly lower browning value than that treated with DW after storage for 2 hrs. After storage for 12 to 24 hrs, potato puree treated with PSE had lower browning value than those treated

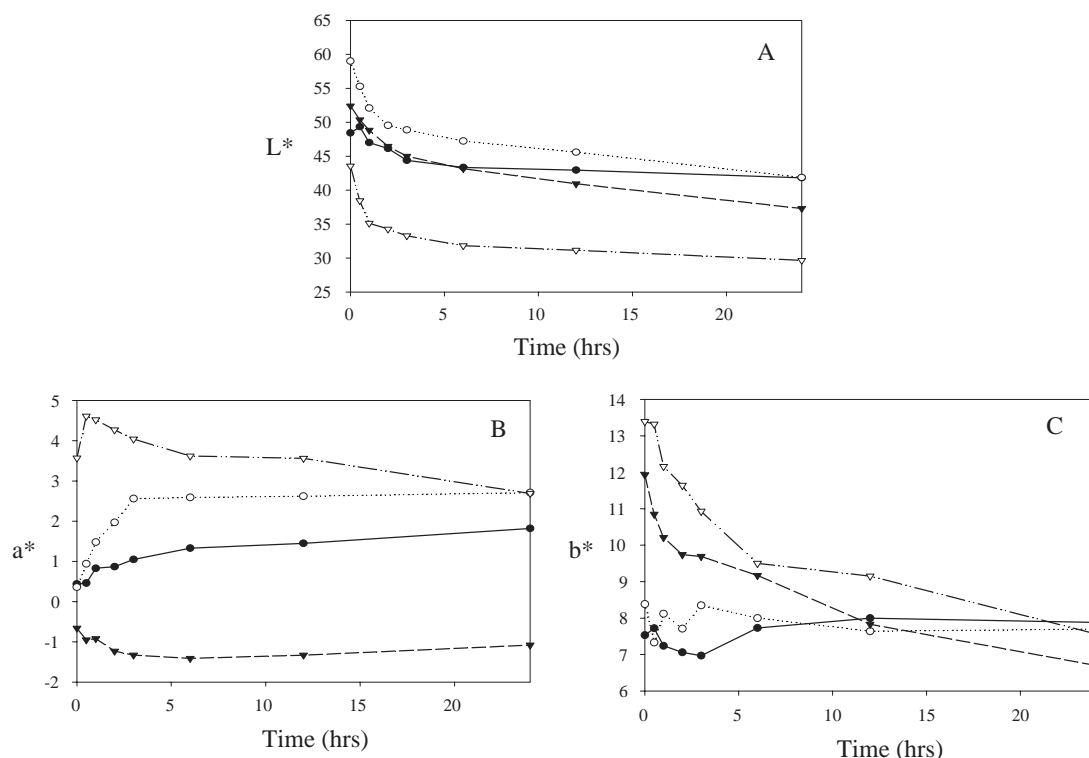


**Figure 1** Browning values ( $((\Delta L^*/L_0^*) \times 100)$ ) of vegetable and fruit blended with distilled water (—◆—, DW), pineapple shell extract (—■—, PSE) and citric acid solution (pH 3.8) (.....▲....., PH) and stored at 5°C for 24 hrs; (A) banana, (B) potato, (C) mushroom and (D) apple puree

with the others. Browning values of mushroom puree treated with PSE, PH and DW were not significantly different during storage for 2 hrs. After storage for 12 to 24 hrs, mushroom puree treated with PSE had higher browning value than those treated with the others. Apple puree treated with PSE had significantly higher browning value than those treated with the others during storage for 24 hrs ( $p \leq 0.05$ ).

$L^*$  values of banana puree treated with PSE decreased less than that of potato, apple and mushroom puree treated with PSE during storage for 2 hrs (Figure 2). The  $a^*$  value of banana puree treated with PSE increased less than that of potato puree during storage while the  $a^*$  value of apple and mushroom puree treated with PSE decreased after storage. The change of  $b^*$  value of banana and potato puree treated with PSE was less than that of mushroom and apple puree during storage.

The decrease of  $L^*$  value means darker color. The increase of  $a^*$  value means higher red color, and the decrease of  $b^*$  value means less yellow color. Thus, the decrease of  $L^*$  and  $b^*$  values and the increase of  $a^*$  value are related with a high browning value (Moline *et al.*, 1999). The results showed that the changes of  $L^*$  and  $a^*$  values in banana puree treated with PSE were lower than those of the other vegetables and fruits as described above. This indicated that the increase of browning in banana puree treated with PSE was less than those of the other puree during storage. This might be due to the more specific inhibition of PSE on PPO isoenzymes in banana than in the others. The PPO isoenzymes in each plant were reported to be different (Labuza *et al.*, 1990). The compounds in PSE that showed the browning inhibitory effects may be phenolic compounds in pineapple shell which was a source of phenolic compounds



**Figure 2** The changes of L\*, a\* and b\* values in banana (—●—), potato (.....○.....), mushroom (—▼—) and apple (—▽—) puree; (A) L\*, (B) a\* and (C) b\* after blended with pineapple shell extract for 5 min and stored at 5°C for 24 hrs.

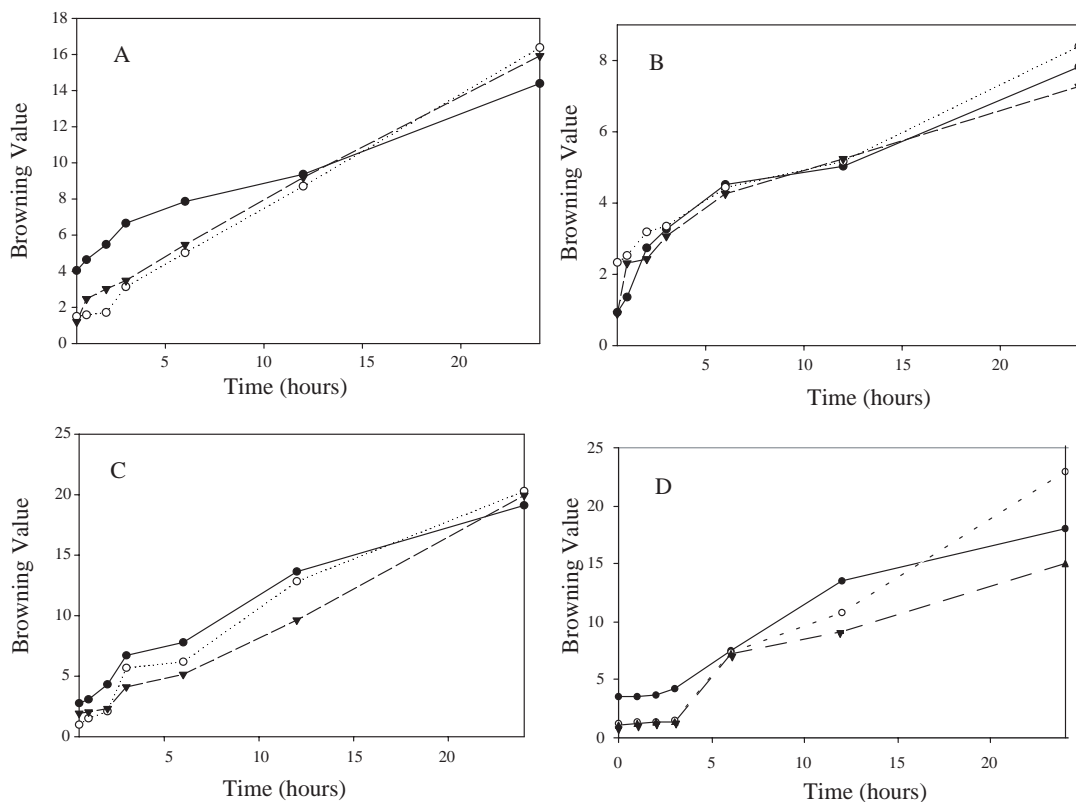
banana slices more effectively than PH and DW which was the similar trend as that of banana puree.

Potato slices treated with PSE had higher browning value than those treated with PH and DW within 3 hrs of storage. After storage for 12 hrs, browning values of potato slices treated with PSE and PH were not significantly different from each other ( $p > 0.05$ ). The results showed that PSE had less browning inhibitory effect on potato slice than potato puree. Since PSE could contact only the surface of potato slice; therefore, it might be the reason that PSE showed less browning inhibitory effect on potato slice. Browning values of mushroom slices treated with PSE and PH were not significantly different during storage for 2 hrs ( $p > 0.05$ ). However, when storage time increased, the browning value of mushroom treated with PH was lower than those treated with the others.

(Larrauri *et al.*, 1997). Rohn *et al.* (2001) reported that phenolic compounds from plants could prevent browning reaction. Iyengar and McEvily (1992) also found that aromatic carboxylic acid of phenolic compounds could inhibit browning reaction as well.

#### Effect of pineapple shell extracts on browning of vegetable and fruit slices

PSE could reduce browning value of banana slices more than PH and DW within 2 hrs of storage (Figure 3). The browning value of banana slices treated with PSE was significantly lower than those treated with the others during storage for 2 hrs ( $P \leq 0.05$ ). The browning values of banana slice treated with PSE, PH and DW were 2.00, 3.10 and 5.80, respectively. This also suggested that PSE could reduce browning in



**Figure 3** Browning values ( $(DL^*/L_0^*) \times 100$ ) of vegetable and fruit slices soaked for 5 min. with distilled water (—●—, DW), pineapple shell extract (.....○....., PSE) and citric acid solution (pH 3.8) (—▼—, PH) and stored at 5°C for 24 hrs (A) banana, (B) potato, (C) mushroom and (D) apple slices

Furthermore, browning value of apple slices treated with PSE and PH were not significantly different within 3 hrs of storage ( $p > 0.05$ ).

The changes of  $L^*$ ,  $a^*$  and  $b^*$  values were shown in Figure 4.  $L^*$  values of banana and potato slices treated with PSE decreased less than those of mushroom and apple slices treated with PSE during storage. Potato, mushroom and apple slices treated with PSE had lower  $a^*$  and  $b^*$  values than that of banana slices.

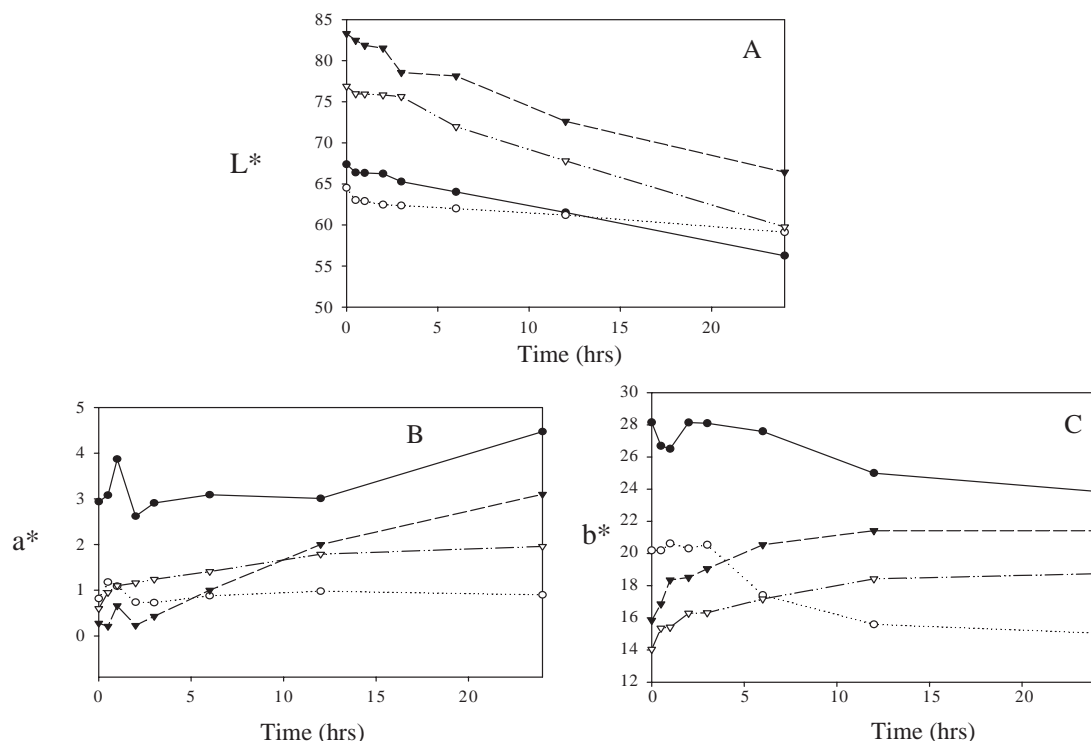
## CONCLUSIONS

Pineapple shell extract (PSE) showed ability to reduce browning values in banana slices more effective than citric acid solution and distilled

water. The increase of browning in banana treated with PSE seemed to be less than those of potato, mushroom and apple during storage. The results suggested that the pineapple shell extracts have a potential to be used as a natural antibrowning agent for banana.

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**Figure 4** The changes of L\*, a\* and b\* values in banana (—●—), potato (.....○.....), mushroom (—▲—) and apple (—▽—) slices; (A) L\*, (B) a\* and (C) b\* after soaked with pineapple shell extract for 5 min and stored at 5°C for 24 hrs.

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