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Effect of Pineapple Juice, Pineapple Shell Extract and Rice Bran Extract on Browning Prevention in Banana [*Musa* (AAA Group) 'Gros Michel'] Slices and Puree

Chockchai Theerakulkait* and Sukhontha Sukhonthara

ABSTRACT

The effects of pineapple juice (PJ), pineapple shell extract (PSE) and rice bran extract (RBE) on browning in the banana slices and puree compared with citric acid solution (pH 3.8) (PH) and distilled water (DW) were investigated by measuring the color changes of the banana slices and puree. RBE treated banana slices had lower browning value than those treated with PJ, PSE, PH and DW after stored for 3 and 12 hrs ($p \leq 0.05$). Their browning values after 12 hrs were 12.05, 17.26, 17.56, 19.54 and 20.59, respectively. The L* values of banana slices treated with RBE were higher while its a* values were lower than those treated with PJ, PSE, PH and DW after stored for 12 hrs. The browning value of RBE treated banana puree (22.63) was lower than those treated with PSE (28.68) and PJ (32.26) after stored for 5 hrs ($p \leq 0.05$).The L* values of banana puree treated with RBE were higher whereas its a* values were lower than those treated with PJ, PSE, PH and DW after stored for 6 hrs. In conclusion, RBE could reduce browning in banana slices and puree more effectively than PJ, PSE, PH and DW.

Key words: enzymatic browning, pineapple juice, pineapple shell extract, rice bran extract, banana

INTRODUCTION

Banana belongs to the genus *Musa* of the family Musaceae (Cano *et al*., 1997). Browning in bananas, as in other fruits, is thought to be due to the enzymatic oxidation of phenolics into quinones, which then polymerize into brown products (Jayaraman *et al*., 1982). Consumer awareness of the risks associated with sulfite-containing anti-browning agents and increased regulatory scrutiny have created the need for substitutes (Iyengar and Mcevily, 1992). Therefore, the various extract from natural sources; for example, honey (Oszmainski and Lee, 1990), grapefruit seed extract (Park *et al*., 1999), rhubarb juice (Son *et al*., 2000), enokitake extract (Jang *et al*., 2002) and onion extract (Kim *et al*., 2005) were investigated for using in prevention of enzymatic browning. Pineapple juice has been reported to inhibit enzymatic browning of fresh and dried apple rings (Lozano-de-Gonzalez *et al*., 1993). A nonvolatile organic acid in pineapple juice was the major inhibitor of enzymatic browning in apple products (Wen and Wrolstad, 1999). Chaisakdanugull *et al*. (2007) reported that malic acid and citric acid played an important role in enzymatic browning inhibition of banana. Larrauri *et al*. (1997) reported that pineapple shell was a source of phenolic compounds such as polyphenols, flavonoids, carotenoids that showed

Department of Food Science and Technology, Faculty of Agro-Industry, Kasetsart University, Bangkok 10900, Thailand.
* Corresponding author, e-mail: fagicct@ku.ac.th

antioxidant activity. Theerakulkait and Saisung (2006) also found that pineapple shell extract could reduce the browning in fruits and vegetables. Kim and Chun (1996) reported that rice bran containing ferulic acid, sinapic, syringic acid, p-coumaric acid and vanillic acid might involve in inhibition of enzymatic browning in vegetables and fruits. Theerakulkait and Boonsiripiphat (2007) also reported that rice bran extract inhibited enzymatic browning in some fruits and vegetables. However, the effect of pineapple juice, pineapple shell extract, rice bran extract compared with citric acid on browning of the banana [*Musa* (AAA Group) 'Gros Michel'] has not been previously investigated. Therefore, the main objective of this research was to investigate the effect of pineapple juice, pineapple shell extract and rice bran extract on browning prevention in Gros Michel banana slices and puree compared with citric acid.

MATERIALS AND METHODS

Preparation of pineapple juice, pineapple shell extract and rice bran extract

Pineapples at ripening stage 4 were obtained from the local market. Pineapple juice was prepared by peeling pineapple which was homogenized in a blender and then centrifuged at 25,650×g for 30 min. Pineapple shells (100 g) were homogenized with 100 ml of the water in a blender and then centrifuged at 19,000×g for 30 min**.** Rice bran (100 g) was homogenized with water (300 ml) for 30 min at 40°C and then centrifuged at 12,000×g for 20 min. The obtained supernatants after centrifugation were pineapple juice (PJ), pineapple shell extract (PSE) and rice bran extract (RBE).

Banana slice preparation and treatment

Bananas [*Musa* (AAA Group) 'Gros Michel'] from the local market were peeled and sliced across with 0.5 cm thick. The slice samples were soaked in PJ, PSE and RBE. As a control, banana slices were soaked in the distilled water (DW) and the citric acid solution (pH 3.8) (PH) for 5 min at room temperature (25°C). The excess liquid was drained, and then the sliced samples were stored at room temperature (25°C) for 24 hrs. The color values (L*, a* and b*) of the samples were measured with Spectrophotometer (CM-3500D, Minolta) at 0, 1, 2, 3, 6, 9, 12 and 24 hr(s) and browning values (($\Delta L^*/L_0^*$) x 100) were calculated; when ΔL^* was equal to L_0^* - L* ; L* was the L* value at any time and L_0^* was the initial L* measurement (Labuza *et al*., 1990).

Banana puree preparation and treatment

Banana puree was prepared by blending 160 g of banana pulp for 30 sec with 80 ml of PJ, PSE, RBE, DW and PH, and the puree samples were stored at room temperature (25°C) for 6 hrs. Then, the L*, a* and b* values of the puree were measured at 0 (initial condition), 0.5, 1, 2, 3, 4, 5 and 6 hr(s) of storage time at room temperature (25°C). The browning values were calculated as described above.

Statistical analysis

Three replications of each experiment were performed. All data were analyzed and tested 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 DISCUSSION

Effect of the pineapple juice, pineapple shell extract and rice bran extract on browning in the banana slices

Browning values and the changes of L*, a* and b* values of banana slices that soaked in PJ, PSE, RBE, DW or PH for 5 min and stored at 25°C for 24 hrs were shown in Figure 1. The browning value was calculated from ($\Delta L^*/L_0^*$) x 100, the lower browning values indicated the

greater effectiveness of browning inhibition. The RBE treated banana slices had significantly lower browning values than those treated with DW and PH ($p \leq 0.05$) after stored for 1 and 2 hrs but was slightly lower than those treated with PJ and PSE ($p > 0.05$). Likewise, the RBE treated banana slices also had significantly lower browning value than those treated with PJ, PSE, DW and PH ($p \leq 0.05$) after stored for 3 hrs to be 2.21, 8.16, 8.06, 10.44 and 14.34, respectively. After storage for 6 hrs, the browning value of banana treated with RBE was slightly lower than those treated with PJ and PSE ($p > 0.05$) but significantly lower than those treated with DW and PH ($p \leq 0.05$). The browning value of banana treated with RBE, PSE, PJ, PH and DW were 5.82, 6.85, 8.11, 13.89 and 14.01, respectively. After storage for 12 hrs, banana slices treated with RBE had significantly lower browning value than those treated with PJ, PSE, PH and DW ($p \leq 0.05$) to be 12.05, 17.26, 17.56, 19.54 and 20.59, respectively. After storage for 18 and 24 hrs, values of the banana slices treated with RBE tended to be lower, but were not significantly different from those treated with others. In conclusion, the results indicated that immersion of banana slices in RBE, PJ and PSE decreased the development of browning occurring during storage. RBE showed the most potent inhibitory effect on the browning occurred in the banana slices during storage.

L* is the luminosity, a* is the position on the green (-) to red (+) axis, and b* is the position on the blue (-) to yellow (+) axis (Girelli *et al*., 2004). The decrease of L* value meaned

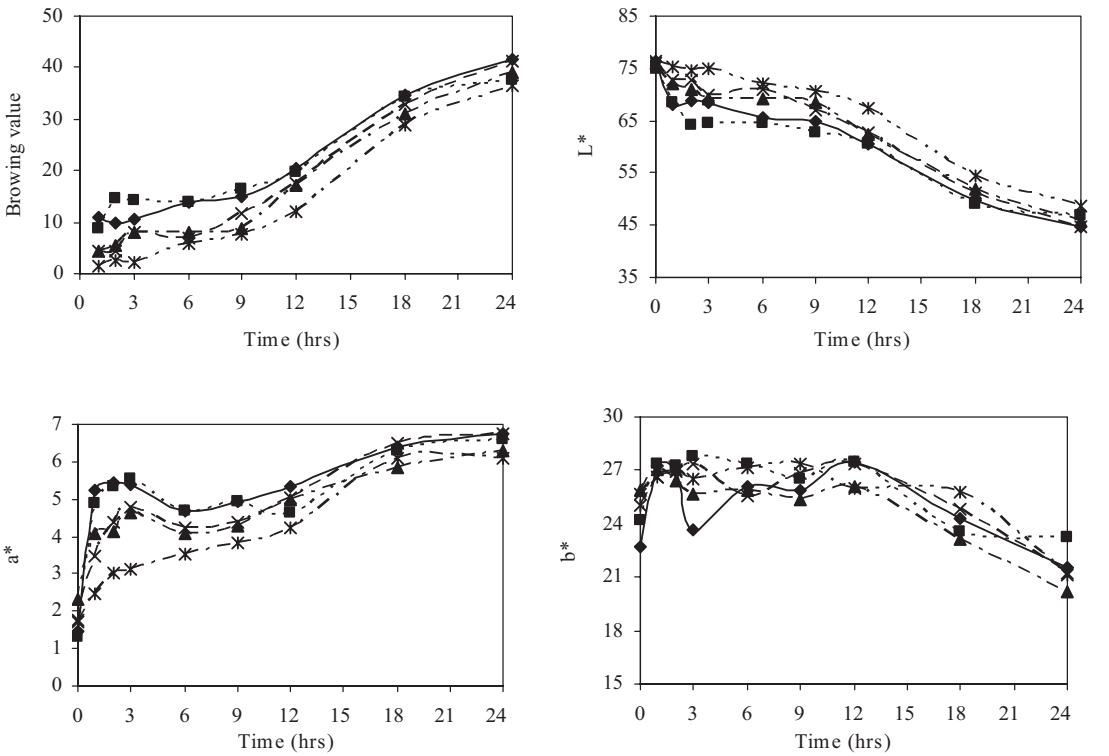

Figure 1 Browning values ($(\Delta L^*/L_0^*) \times 100$) of the banana slices soaked for 5 min. in the pineapple juice (—▲— -, PJ), pineapple shell extract (—✕— -, PSE), rice bran extract (—✳— -, RBE), distilled water (—◆—, DW) and citric acid solution pH 3.8 (·····■·····, PH) and stored at room temperature (25°C) for 24 hrs.

darker color and the increase of a* value meaned higher red color. Thus, the decrease of L* value and the increase of a* value indicate with a high browning color (Moline *et al.*,1999). L* value of banana slice treated with RBE was not significantly higher than that treated with PJ and PSE ($p>0.05$) but significantly higher than that treated with DW and PH ($p\leq0.05$) after stored for 2 and 9 hrs. After storage for 12 hrs, banana slice treated with RBE had significantly higher L* value than those treated with others. However, the L* value of banana slice treated with RBE tended to be higher, but not significantly different from those treated with others after stored for 18 and 24 hrs. Banana slices treated with RBE had significantly lower a* values than those treated with others after stored for 2 hrs. After storage for 9 hrs, a* value of banana slice treated with RBE was not significantly lower than those treated with PJ and PSE ($p>0.05$) but significantly lower a* value than those treated with DW and PH ($p\leq0.05$). The a* value of banana slice treated with RBE trended to be lower, but not significantly different from those treated with others after stored for 24 hrs. The b* value of banana slice treated with RBE was not significantly higher than those treated with PSE, DW and PH ($p>0.05$) but significantly higher than that treated with PJ ($p\leq0.05$) after stored for 9 hrs. After storage for 18 hrs, b* value of banana slice treated with RBE tended to be higher, but not significantly different from those treated with others. In conclusion, the results showed that the change of L*, a* and b* values in the banana slices treated with RBE were lower than others during storage. Thus, the RBE was effective in the browning prevention in the banana slices during storage.

Effect of the pineapple juice, pineapple shell extract and rice bran extract on browning in the banana puree

Browning values and the changes of L*, a* and b* values of the banana puree blended with PJ, PSE, RBE, DW or PH and stored at 25°C for 6 hrs were shown in Figure 2. Browning value of the banana puree treated with RBE was not significantly lower than those treated with PH and PSE ($p>0.05$) but significantly lower than those treated with DW and PJ ($p\leq0.05$) after stored for 0.5 hr. The browning values of the banana puree treated with RBE, PH and PSE after stored for 0.5 hr were 14.71, 18.04, 18.31, 18.81 and 20.33, respectively. After storage for 3 hrs, the browning values of the banana puree treated with RBE (18.92) was significantly lower than those treated with PH (23.25), PSE (25.13) and PJ (26.29) ($p\leq0.05$). After storage for 5 hrs, the browning values of the banana puree treated with RBE (22.63) was also significantly lower than those treated with PSE (28.68) and PJ (32.26) ($p\leq0.05$). During storage for 0.5-6 hrs, the L* values of banana puree treated with RBE were significantly higher while their a* values were lower than those treated with others ($p\leq0.05$). The b* value of banana puree treated with RBE was similar to those treated with PJ, PH and DW ($p>0.05$) but lower than that treated with PSE ($p\leq0.05$) after stored for 1 hr.

According to the results, it demonstrated that RBE was more effective in browning inhibition of the banana slices and puree than PJ and PSE. This might be due to the browning inhibitory effect of the phenolic compounds in RBE on banana. Kim and Chun (1996) found that rice bran contained phenolic compounds such as ferulic acid, sinapic, syringic acid, p-coumaric acid and vanillic acid. Miyazawa *et al.* (2003) also found that phenolic compounds in black rice bran such as protocatechuic acid showed an inhibitory effect on tyrosinase activity. Some researchers also reported that p-coumaric acid, ferulic acid and sinapic acid were effective in inhibition of enzymatic browning in potato (Macrae and Duggleby, 1968) and apple (Pifferi *et al.*, 1974; Walker and Wilson, 1975). Thus, the phenolic compounds in RBE might be the compounds that

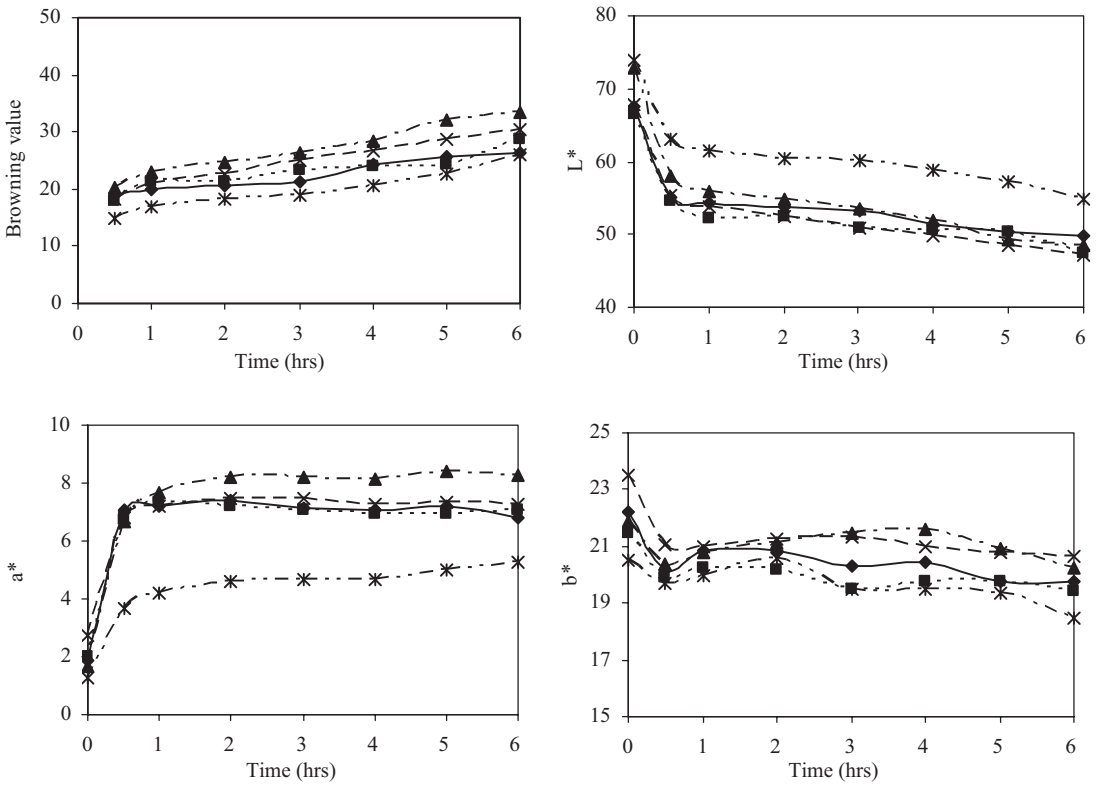

Figure 2 Browning values (($\Delta L^*/L_0^*$) x100) of banana puree blended in pineapple juice (—▲— -, PJ), pineapple shell extract (—✕— -, PSE), rice bran extract (—✳— -, RBE), distilled water (—◆—, DW) and citric acid solution pH 3.8 (·····■·····, PH) and stored at room temperature (25°C) for 6 hrs.

had browning inhibitory effect in the banana slices and puree.

CONCLUSION

Rice bran extract (RBE), pineapple juice (PJ) and pineapple shell extract (PSE) showed the ability to reduce browning values in the banana slices and puree. However, the extent of the browning in the banana slices and puree treated with RBE appeared to be less than PJ, PSE and citric acid solution during storage. The results suggested that the rice bran extract has the potential to be used as a natural antibrowning agent for the banana slices and puree.

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