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Effect of processing treatments on the colour of dokong (*Lansium domesticum* Corr.) juice

[Kesan rawatan pemprosesan terhadap warna jus dokong *(Lansium domesticum* Corr.)]

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Key words: processing, treatments, colour, dokong, *Lansium domesticum* Corr., juice

Abstract

The fruit *Lansium domesticum* Corr. is commonly known in Malaysia as dokong. This species is from the Meliaceae family. One of the problems faced in the processing of dokong juice is the colour change due to browning reaction. Thus studies were conducted to improve the colour of the dokong juice. Four soaking treatments were selected from preliminary trials for further evaluation viz. soaking the peeled fruits in 1% salt solution followed by steaming for 2.5 min (GS); soaking in 0.2% sodium metabisulphite followed by steaming for 2.5 min (MS); soaking in 0.2% sodium metabisulphite (MET) and soaking in water (W). Canned juices prepared using the four treatments were significantly different in the L*, a* and b* colour values. The juice prepared from peeled fruits soaked in 0.2% sodium metabisulphite followed by steaming (MS) had the lightest colour as reflected by the higher L* values obtained. This was followed by MET, G and W samples in descending order of lightness.

Introduction

The fruit *Lansium domesticum* Corr. is commonly known in Malaysia as dokong while in Thailand it is known as longkong. This species is from the Meliaceae family. The crop is believed to be originated from Thailand and is grown in Malaysia in the states of Kelantan, Terengganu, Johor, Pahang and Kedah (Anon. 2005). Fresh dokong is a popular fruit in Malaysia with good organoleptic characteristics such as flavour and colour. The fruit is usually consumed fresh, but during the glut season farmers have difficulty in selling the fruit as well as getting a good price for their crop. As such, MARDI has undertaken studies to develop value added products from this fruit. Among the products studied is canned dokong juice.

Besides taste, colour is one of the major characteristics affecting the acceptability of juices. Visual colour is an important characteristic as it is usually the first property the consumer observes. One of the problems faced in processing dokong juice is the colour change of the juice due to enzymic browning reaction. This is noticeable when peeled fruits are left standing for some time while awaiting the peeling process to finish for the bulk of the fruits. Non-enzymic browning is also another major factor in quality loss of processed juices. Thus studies were conducted to improve the colour of the dokong juice using low cost methods in order to increase the commercial value of the fruit as well as to provide a method suitable for the small industries to take up.

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Materials and methods

Preliminary study

Ripe *Lansium domesticum* Corr. fruits were obtained from a farm in Kelantan. A preliminary study was conducted to test eight treatments on the fruits. Eight batches of 250 g fruits from the same lot of fruit were peeled and immediately treated as follows: (a) unsoaked, (b) soaked in tap water, (c) soaked in 1% salt (sodium chloride) solution or (d) soaked in 0.2% sodium metabisulphite solution. Peeled samples were left for 1.5 h after the last fruit was peeled according to the treatments. These four treatments were then repeated whereby the samples after standing were further steamed for 2.5 min using a single layer steamer pot. Samples were taken to determine the flesh colour at the top distal end of the fruit after each treatment. Freshly peeled fruit was also evaluated for comparison. Duplicate trials were conducted using the same supply of fruits.

Dokong juice processing

For the production of fruit juice, fruits in 5 kg batches from a second lot were washed and then manually peeled and soaked. Four soaking treatments were evaluated viz. soaking the peeled fruits in 1% salt solution followed by steaming for 2.5 min (GS); 0.2% sodium metabisulphite followed by steaming for 2.5 min (MS); 0.2% sodium metabisulphite (MET) and soaking in water (W).

Fruits were immediately soaked in the soaking water (5 kg) after being peeled. Each batch took 1.5 h to peel from the first fruit to the last fruit. The fruits were left to soak for half an hour while the pulper was setup for juice extraction. The peeled fruits were rinsed in running water and drained after soaking. The juice was then extracted using a pulper (Reeves, USA) with sieve no. 023 to separate the seeds and coarse pulp from the juice using four passes through the pulper. The juice was heated to 90 °C in a jacketed kettle and hot filled into 206 x 408 cans which was then seamed and then pasteurized at 90 °C for 3 min in a jacketed kettle. Two batches were prepared for the evaluations from the same supply of fruits.

Colour evaluation

Flesh colour was determined using Chroma meter CR300 (Minolta Camera Co.) based on the CIE 1976 L*a*b* colour system. The equipment was calibrated using a reference white tile for the Y, x, y values of 92.5, 0.3134 and 0.3194, respectively. Fruit flesh was measured at the top distal end of the fruit where colour change was most obvious. Six measurements were made for each treatment of the preliminary study. Determination of colour was carried out on the samples of extracted juice using a Chroma meter CR300 attached to a liquid measuring unit CT-310.

Liquid samples were measured using sample cells of optical path length 20 mm (CT-A20). The equipment was calibrated using distilled water. Colour readings were obtained for 15 samples for each treatment and the results averaged. Samples were also evaluated after 8 months storage at 28 ± 2 °C. Colour was also evaluated by 25 panellists on the colour acceptability of the juice after the canned products were stored for 8 months, using a 9-point hedonic rating scale ranging from 1 (dislike extremely) to 9 (like extremely) (Larmond 1977).

Physico-chemical analysis

The pH and total soluble solids were determined using an Orion pH meter and Atago hand held refractometer, respectively.

Data analysis

For data analyses of L*, a*, b* values and organoleptic mean colour scores, the SAS (Statistical Analysis System) programme release 8.01 was used (SAS Inst. 2000). The values obtained were tested using Duncan multiple range test.

Results and discussion

Preliminary studies indicated that all treatments including the freshly peeled fruits gave significantly (p <0.05) lighter coloured fruit flesh compared to unsoaked peeled fruits which were left standing for 1.5 h, as indicated by the higher L* values *(Table 1)*. The findings showed that peeled fruits soaked in sodium metabisulphite or water or salt solution were significantly lighter in colour than unsoaked peeled fruits. Soaked peeled fruits in MS, WS and GS treatments were comparable in L* values to the freshly peeled fruits. Studies by Ramaswamy and Ranganna (1989) showed that blanched cauliflower following a brief dip in metabisulphite solution prior to freezing gave a superior product, even when stored for 1 year.

Overall, soaked samples which were steamed were lighter in colour than unsteamed soaked samples of the same soaking medium. This is probably due to the effect of heat on the enzymes in the fruit as well as the effect of heat on the fruit flesh which was initially translucent but became opaque white after steaming. The a* value for peeled fruits soaked in sodium metabisulphite and steamed (MS) was lowest (least red) among the treated samples. Similarly its b* value (least yellow) was also lowest. Sulfur dioxide or sulfites have been observed to inhibit the phenolase enzyme system and hence control browning (Haard 1976).

Visually, the browning of the fruit was more obvious and faster at the distal top end of the fruit and between fruit segments rather than the flesh itself due to the presence of cell membrane that remains between the segments when the fruit is peeled. This membrane is on the inner layer of the fruit skin which continues into the middle of the fruit and coats each individual segment. When fruit is peeled, the cell membrane is broken and the fruit is exposed to light and oxygen. Browning on cut or bruised surfaces of plant tissues occurs when polyphenoloxidase or phenolase catalyses oxidative conversion of phenolic substances to brown end products.

The soaking treatments used are the common methods used to control enzymic browning in fruits which are mainly due to phenolase activity. Oxygen is excluded by means of the soaking medium and the reaction is inhibited by salt or sulphites. Steaming is, primarily, to inactivate the enzymes and remove air from tissue.

Canned juices prepared with the four soaking treatments i.e. salt and steam, sodium metabisulphite and steam, sodium metabisulphite, and water, were significantly different in their colours with respect to the L*, a* and b* values *(Table 2)*. Immediately after canning, the products soaked in 0.2% sodium metabisulphite followed by steaming (MS) gave significantly (p <0.05) lighter colour than the other three treatments as reflected by the higher L* values obtained

Table 1. L*, a*, b* values of *Lansium domesticum* Corr. fruit flesh at top distal end of fruit

Treatment	L*	a*	b*
Freshly peeled fruit	58.49 ± 3.36ab	1.41 ± 1.23cde	10.27 ± 1.58ab
Fruit left to stand unsoaked (U)	45.75 ± 3.54e	5.95 ± 1.41a	10.28 ± 1.86ab
1% salt solution (G)	50.08 ± 4.51d	2.72 ± 1.77bc	6.81 ± 1.62cde
Soaked in water (W)	51.11 ± 1.97d	2.10 ± 0.69cd	8.02 ± 2.08bcd
0.2% sodium metabisulphite (MET)	55.69 ± 3.21bc	0.09 ± 0.68ef	5.52 ± 1.07de
Unsoaked and steamed (US)	52.99 ± 3.84cd	4.05 ± 2.55b	12.04 ± 3.29a
1% salt solution and steamed (GS)	56.37 ± 4.48abc	0.64 ± 1.69def	5.22 ± 2.32de
Soaked in water and steamed (WS)	58.34 ± 2.15ab	0.19 ± 0.45ef	8.52 ± 3.04bc
0.2% sodium metabisulphite and steamed (MS)	60.51 ± 1.35a	–0.84 ± 0.84f	4.20 ± 2.26e

Means with the same letter within the same column are not significantly different (p <0.05)

Table 2. L*, a* b* values of canned *Lansium domesticum* Corr. juice at 0 month

Treatment	Total soluble solids (°Bx)	pH	L*	a*	b*
1% salt solution + steam (GS)	16	4.15	2.64 ± 0.05c	+2.37 ± 0.14a	+3.60 ± 0.06b
0.2% sodium metabisulphite + steam (MS)	15	4.27	2.94 ± 0.08a	+1.47 ± 0.15c	+3.71 ± 0.07a
0.2% sodium metabisulphite (MET)	15	4.16	2.82 ± 0.07b	+1.36 ± 0.16c	+3.37 ± 0.12c
Water (W)	16	4.25	1.04 ± 0.03d	+1.91 ± 0.20b	+1.64 ± 0.12d

Means with the same letter within the same column are not significantly different (p <0.05)

Table 3. L*, a*, b* values of canned *Lansium domesticum* Corr. juice after 8 months of storage

Treatment	L*	a*	b*
1% salt solution + steam (GS)	1.80 ± 0.06c	2.97 ± 0.22a	2.81 ± 0.12c
0.2% sodium metabisulphite + steam (MS)	3.62 ± 0.15a	2.60 ± 0.18b	5.16 ± 0.21a
0.2% sodium metabisulphite (MET)	2.54 ± 0.07b	2.04 ± 0.22d	3.45 ± 0.13b
Soaked in water (W)	1.14 ± 0.10d	2.28 ± 0.13c	1.81 ± 0.20d

Means with the same letter within the same column are not significantly different (p <0.05)

Table 4. Organoleptic mean colour scores of canned *Lansium domesticum* Corr. juice after 8 months of storage

Treatment	Mean colour score
1% salt solution + steam (GS)	5.16 ± 1.40bc
0.2% sodium metabisulphite + steam (MS)	6.22 ± 1.57a
0.2% sodium metabisulphite (MET)	6.20 ± 1.19ab
Soaked in water (W)	5.08 ± 1.50c

Means with the same letter within the same column are not significantly different (p <0.05)

(Table 2). This was followed by MET, GS and W samples in descending order of lightness. Thus the colour of fruit juice can be improved by these treatments.

After 8 months of storage, the canned fruit juice still showed similar effect of the treatments as for the freshly processed canned juice *(Table 3)*. Also, the L* values of samples stored for 8 months were significantly different (p <0.05) from samples at 0 month. Those prepared by soaking in salt with steaming (GS), as well as those prepared by soaking in sodium metabisulphite (MET) became darker while the other two treated samples were lighter. Visual examinations of the stored canned products by panellists concurred with the chromameter results as shown by the higher mean scores for MS followed by MET, GS and W *(Table 4)*. The amount of difference in L* values between the stored and fresh samples was greater for MS and GS samples.

Studies by Nagy et al. (1990) indicated that browning occurred faster and developed more intensely in bottled grapefruit juices as compared to canned juices when stored at 10–50 °C over 18 weeks. This could be due to the fact that some brown pigments which were unstable diminished with extended storage time while others increased with time.

In this case, the sodium metabisulphite and steaming treatment was able to prevent enzymic and non-enzymic browning effectively and hence the colour was light even upon 8 months of storage. Hodge and Osman (1976) also reported that sulphurous acid and sulfites are generally effective in inhibiting browning reactions and extending the shelf life of fruit juices.

During storage, accumulation of brown colour is attributed mainly to non-enzymic reactions since enzymes causing enzymic browning being susceptible to heat is eliminated by heat treatment during processing (Babsky et al. 1986; Ibarz et al. 1990; Martinez and Whitaker 1995). These reactions involve caramelisation, ascorbic acid degradation, and Maillard reaction.

Lightness (L*) values of Golden Delicious apple juice concentrates were reported decreasing with increasing storage time and storage temperature whereas Amasya apple juice concentrates stored at 5 °C and 20 °C had almost the same values of lightness (Burdurlu and Karadeniz 2003). The storage of orange juice at 4 °C causes slight decrease in L* values whereas at 10 °C there is a significant increase in L* value in the three types of juices (Esteve et al. 2005).

Conclusion

The colour of canned *Lansium domesticum* Corr. juice can be improved by soaking the peeled fruits in 0.2% sodium metabisulphite followed by steaming for 2.5 min. This processing treatment gave the lightest colour to the juice when compared to soaking methods involving 1% salt solution followed by steaming, 0.2% sodium metabisulphite or just soaking in water.

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Abstrak

Buah *Lansium domesticum* Corr. lebih dikenali dengan nama dokong di Malaysia. Species ini dari famili Meliaceae. Salah satu masalah pemprosesan jus dokong ialah perubahan warna jus yang disebabkan oleh tindak balas pemerangan. Oleh itu kajian telah dijalankan bagi membaiki warna jus dokong. Empat kaedah rendaman telah dipilih dari uji kaji awal iaitu merendam buah yang telah dikupas di dalam larutan garam 1% diikuti dengan pengukusan untuk 2.5 min (GS); merendam di dalam 0.2% natrium metabisulfit diikuti dengan pengukusan untuk 2.5 min (MS); merendam di dalam 0.2% natrium metabisulfit (MET) dan merendam di dalam air (W). Jus yang telah ditinkan menggunakan empat kaedah ini berbeza dengan ketara dari aspek nilai L*, a* and b* apabila warna jus diuji. Jus yang disediakan dengan rawatan 0.2% natrium metabisulfit dan pengukusan (MS) mempunyai warna yang paling cerah seperti ditunjukkan oleh nilai L* yang lebih tinggi. Ini diikuti oleh sampel MET, G dan W mengikut aturan menurun kecerahan.

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