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Storage Study of *Arenga pinnata* Juice

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Abstract

Palm juice is a sweet natural beverage obtained from *Arenga pinnata*, a type of palm tree The objective of this study is to investigate the physicochemical properties (colour, pH and TSS) that can contribute to the changes of taste and appearance of palm juice. The juice was kept at room temperature, 30 ± 0.5 °C and in refrigerator, 4 ± 0.5 °C, and evaluated at various intervals for a month. The longer the storage time, the TSS content and pH value of the palm juice will decrease. Furthermore, the colour of fresh palm juice will be decolourize into dull colour.

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Keywords: Fruit palm; beverages; total soluble solids

1. Introduction

Fresh palm sap, palm juice or *air nira,* obtained from palm tree (*Arenga pinnata*) is a sweet and transparent natural beverage. It is a popular traditional beverage in Malaysia besides palm juice obtained from coconut (*Cocos nucifera*) and *Nipah* (*Nypa fructicans*). It also applied as a sweetener after going through heating process (Ho et al. 2007). Palm juice is obtained by tapping the unopened spadix of the palm tree. The apex of the stalk is sliced about 1 – 5 mm during tapping process. Then, a bamboo pipe is inserted into the base in order to collect the sap into a gourd. Devdas, Sundari, and Susheela (1969) reported that the palm juice is highly nutritious and serves as a good digestive agent. Palm juice is transparent, with a sugar content of 100 – 144 g/kg, a pH of 7.0 – 7.4 and traces of ethanol (Lasekan et al., 2007). The sap or juice collected from palm trees contains around 10 – 12 % total sugars; mainly comprised of sucrose, less amount of reducing sugars and other minerals and vitamins (Dalibard, 1999). Palm juice represents the main income-generating activity for the farmers living in several rural communities which depend on

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the palm trees for the living.

From the consumer perspective, the most appealing features of palm juice are their flavour and nutrition. Food flavour appreciation is one of the first evaluation signals along with food appearance and texture encountered by consumers during consumption of food. Palm juice is a very sweet beverage and non alcoholic before it fermented. However, the shelf life of palm juice is very short. After four hours exposure at environment temperature, the palm juice will be fermented into alcoholic beverages called palm wine. To date, theres only one research from Fahrizal et al. (2013) has been published on alcoholic fermentation of *Arenga pinnata* juice. The objective of this study is to investigate the physicochemical properties (colour, pH and total soluble solids (TSS)) that can contribute to the changes of taste and appearance of palm juice.

2. Materials and methods

2.1 Material

Fresh palm juice (*Arenga pinnata*) was collected from palm trees grown at Bukit Persekutuan, Kuala Lumpur in two batches which 1.5 L for every batch. The samples were collected by using transparent plastic bag and stored in the freezer, -20 ± 0.5 °C until further analysis. The initial pH, total soluble solid (TSS) were measured and original colour of the palm juice were captured immediately upon arrival.

2.2. Analysis of palm juice

Overall methodology is presented in Fig. 1. The analyses involved are colour, pH and also total soluble solid (TSS). Three samples of palm juice were prepared for each conditions; environment temperature, 32 ± 0.5 °C and in refrigerator, 4 ± 0.5 °C. Distilled water was used as a control.

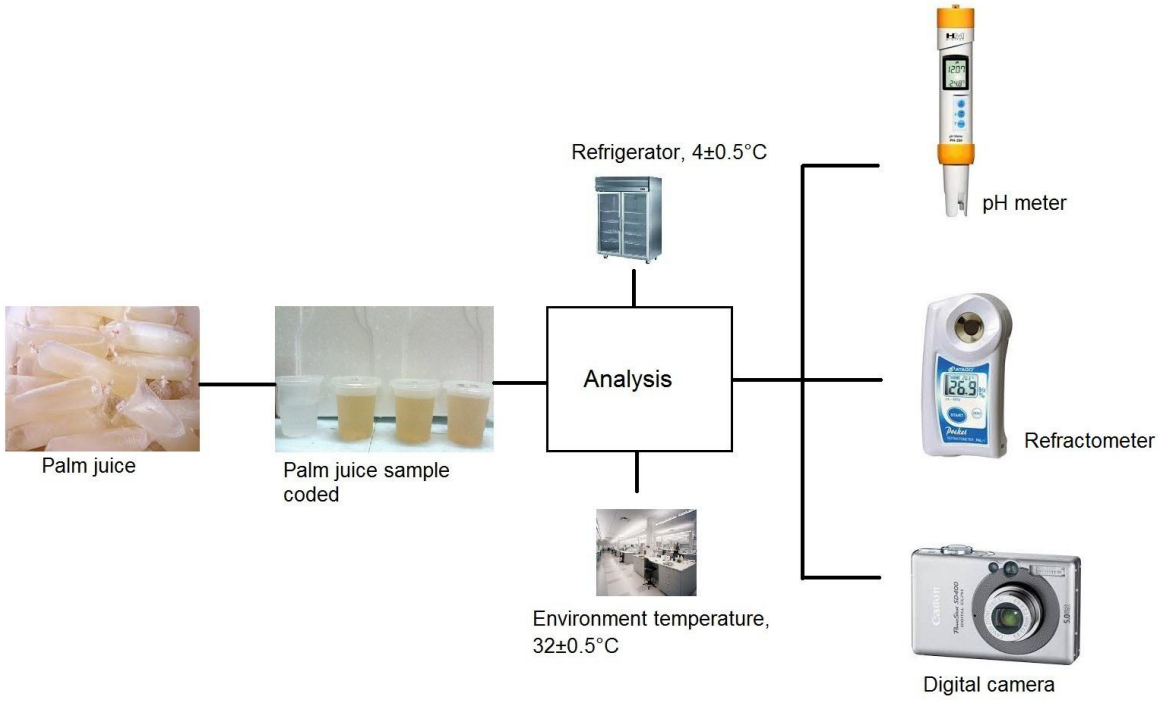

Fig. 1. Overall methodology for investigation of alcoholic fermentation of palm juice.

2.2.1 pH analysis

The pH of the sample was measured using a pH metre (Mettler Toledo, Switzerland). The average of three replicates of pH were recorded for each samples and used for drawing curves.

2.2.2 Total soluble solid (TSS)

Using the same sample, the total soluble solids (TSS) was measured directly using a refractometer (Atago PAL-1, Japan) (Salvador et al. 2007, Suntharalingam and Ravindran, 1993). The TSS content of a solutionwas determined by the index of refraction and referred to as degrees of Brix.

2.2.2 Colour

Colour change was initially judged by visual examination of palm juice that was examined in a clear plastic cup at different interval of time. In addition to this, a high-resolution digital camera (Model A2300, Canon Digital Lab, Malaysia) was used to measure colour by capturing the colour image of the palm juice sample as the method described by Leon, Mery, and Leon (2006). The images were analyzed qualitatively and quantitatively by using Adobe Photoshop (Yam and Papadakis, 2004). The colour values from Adobe Photoshop were not the standard colour values. These values converted into CIE L^*, a^*, b^* standard values using the following equations (Yam and Papadakis, 2004).

$$L^* = \frac{Lightness}{255} \times 100 \quad (1)$$

$$a^* = \frac{240a}{255} - 120 \quad (2)$$

$$b^* = \frac{240b}{255} - 120 \quad (3)$$

The parameters obtained were L^* representing the brightness of the colour ($L^* = 0$ [black], $L^* = 100$ [white]), a^* ($-a$ = greenness, $+a$ = redness) and b^* ($-b$ = blueness, $+b$ = yellowness). The average of three replicates for L^*, a^* and b^* were recorded.The colour differences (ΔE) between two samples were estimated using the following equation (Siddiqui and Nazzal, 2007).

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (4)$$

3. Results and discussion

3.1 pH measurement

Fig. 2 shows the pH value decrease for both conditions; environment temperature (6.11 to 2.71) and in refrigerator (6.10 to 5.67) after 30 days storage time. The relationship between pH and time is clearly presented at environment temperature, 32 ± 0.5 °C. For samples in refrigerator, the pH decrease slowly compared to samples at environment temperature. The decreasing of pH was explained by the accumulation of the compounds of the acidic by some microorganisms that present in palm juice (Judoamidjojo et al., 1989). The palm juice has a sweet taste and pleasant smell and the initial pH of 6.10. However, according to Dachlan (1984), the *Arenga* palm juice has a degree of acidity with pH 5.5 to 6.0. pH changes during fermentation presented in Fig. 2.

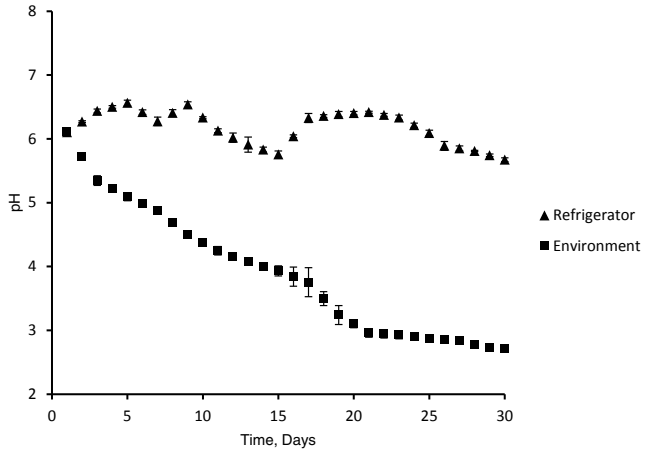

Fig. 2. pH changes at environment temperature, 32 ± 0.5 °C and in refrigerator, 4 ± 0.5 °C.

3.2 Total soluble solids (TSS) analysis

The initial total soluble solid (TSS) in the *Arenga* juice was 12.4 °Brix. Changes in the levels of soluble solids of palm juice during fermentation are presented in Fig. 3., which shows the concentration of soluble solids for both refrigerator and environment temperature decrease with increasing of storage time. TSS at environment temperature, were decrease from 12.4 to 5.37 °Brix. This is because of fast decomposition of the soluble solids due to high temperatures. Microorganism present in the palm juice use soluble solids as an energy sources. According to Legaz et al. (2000), yeast activity decompose soluble solids especially sugars into ethanol so the sugar content will be declined. Availability of soluble solids such as sugar is one of the factors that influence the involvement of the microorganisms in fermentation where the soluble solids serve as a nutrient source.

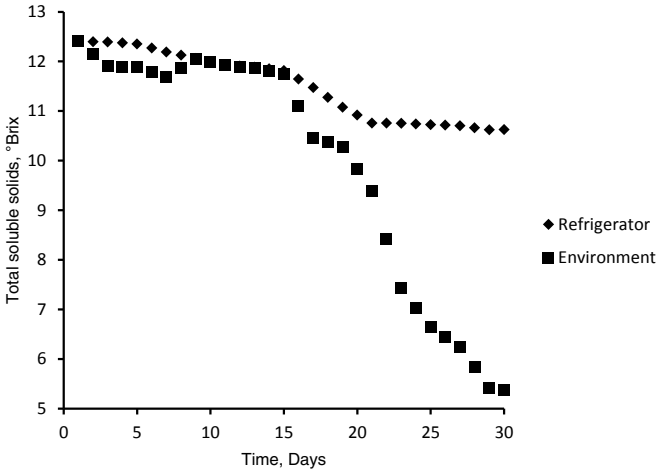

Fig. 3. Total soluble solids (TSS), °Brix changes during the fermentation.

3.3 Change in colour during fermentation

Fig. 4 shows the changes in colour of *Arenga* palm juice samples with the increase in total soluble solids (TSS).

Samples at environment temperature, 32 ± 0.5 °C and in refrigerator, 4 ± 0.5 °C showed similar trends; the colour of the juice changes from yellow brownish to dull colour (low *a**, *b** and high *L** values). Initially, there was a rapid change in *L** value (darkness to lightness) from 12.4 °Brix to 5.4 °Brix for samples both conditions. However, *a** and *b** values changed slowly throughout the process. Further fermentation process caused continuous change of *L**, *a** and *b** values and the colour of the palm juice changed towards dull colour, suggesting onset of decolourisation process. The successive change in colour of the palm juice with the change of total soluble solids (ΔE/ΔTSS) is presented in Fig. 5. The trends are also almost similar for both condition; environment temperature, 32 ± 0.5 °C and in refrigerator, 4 ± 0.5 °C. From the result, the relationship between TSS and colour were determined. A small change of TSS value of the palm juice will minimize the colour change during storage.

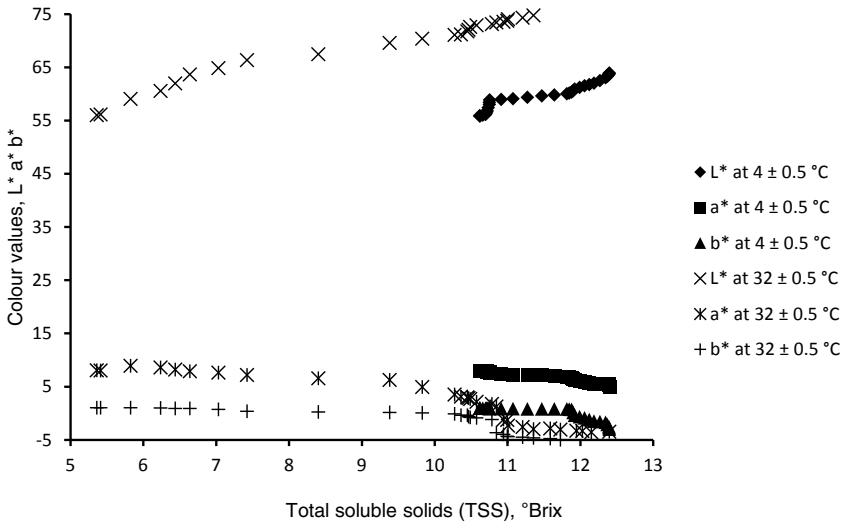

Fig. 4. Change in colour values for *Arenga* juice samples with the increase in total soluble solids at refrigerator temperature, 4 ± 0.5 °C and environment temperature, 32 ± 0.5 °C.

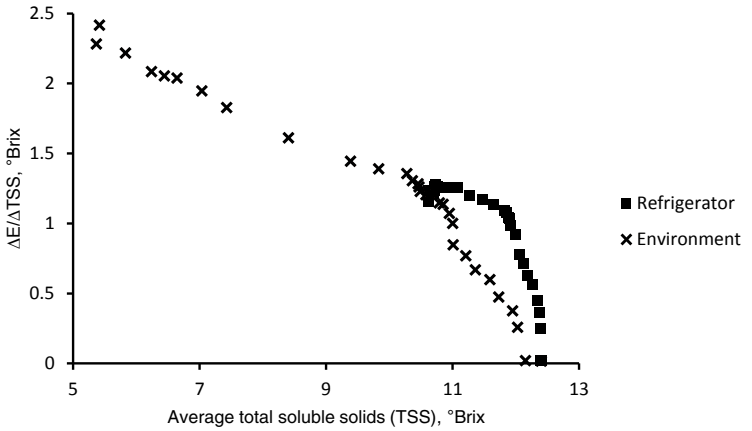

Fig. 5. Successive change in total colour value (ΔE) with the corresponding change in total soluble solid (ΔTSS) for *Arenga* juice samples at different total soluble solid.

4. Conclusions

The longer the storage time, the total soluble solid (TSS) content and pH value of the palm juice will decrease. Furthermore, the colour of fresh palm juice will be decolourize into dull colour. From the result, further studies need to be conducted in order to maintain the pH and TSS so that the original taste of the palm juice was not destroyed. It is expected that the results of this study will be useful for the development of palm juice into beverages product.

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