Malays. Appl. Biol. (2013) 42(1): 67–71

THE QUALITY OF ROSELLE (*Hibiscus sabdariffa* L.) JUICES MADE FROM ROSELLE CALYCES STORED AT DIFFERENT COLD TEMPERATURES

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ABSTRACT

Roselle (*Hibiscus sabdariffa* L.) from the family of Malvaceae is normally referred to the calyces which have brilliant red color and unique flavor that makes it a valuable food product commonly used to make preserves, jams and beverages. This study was conducted to determine the physico-chemical characteristics and sensory acceptability of rosellejuices made from roselle calyces stored at different cold storage temperatures; 5±1°C, -19±1°C, -80±2°C for 7 days and fresh roselle was used as control. The physico-chemical characteristics studied were colour, total soluble solids, titratable acidity, ascorbic acid and anthocyanins contents. The sensory evaluation was also carried out which involved the acceptability test on the attributes of colour, aroma, taste (sweetness and sourness) and overall acceptability. Roselle juicesmade from frozen roselles (-19±1°C and -80±2°C) showed significantly higher L* values followed by roselles stored at 5±1°C and fresh roselles. In addition, juice made from fresh roselle had significantly the highest a*, b* values and anthocyanins content followed by roselle stored at 5±1°C and -80±2°C where juice made from roselle stored at -19±1°C showed the lowest values. However, for ascorbic acid content, fresh roselle also showed the highest value followed by roselle stored at -80±2°C, -19±1°C and the lowest was roselle stored at 5±1°C. The sensory evaluation showed that, roselle juice made from fresh calyces was the most acceptable in almost all the attributes compared to chilled and frozen roselles. In conclusion, juice made from fresh roselle had almost all the preferred physico-chemical qualities and sensory acceptability as compared to the chilled and frozen roselles.

Key words: Roselle (*Hibiscus sabdariffa L.*), juice, physico-chemical characteristics, sensory acceptability

INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.), an annual shrub, is commonly used to make preserves, jams and beverages (Abu-Tarboush *et al.*, 1997; Tsai *et al.*, 2002) . The brilliant red colour and unique flavour make it a valuable food product. Roselle juice is quite popular among the populace presumably due to its attractive colour, pleasant flavour and nutritional attributes (Tsai *et al.*, 2002). Government takes proactive actions to increase the awareness of Malaysians regarding nutrition and benefits that can be obtained from roselle. Malaysian Agricultural Research and Development Institute (MARDI) had done many researches on roselle calyces which have potentially a good source of antioxidants and high contents of vitamin C. Roselle juice is claimed to be a new prohealth drink due to these high nutrition values. In this study, the matured roselle calyces from variety UKMR-2 were harvested from roselle trees planted on Beach Ridges Interspersed with swales (BRIS) soil. The harvested rosells were stored at chilling temperature of 5±1°C and freezing temperatures of -19±1°C and -80±2°C. This study was aimed to determine the effects of different cold temperatures storage on the physico-chemical properties and sensory acceptability of roselle juice. In the roselle industry, processing and selection of cold preservation of roselle after harvest have significant effect on the quality of roselle products. The effects of different storage temperatures used to store roselle calyces on colour, vitamin C and antocyanin retention in roselle juice were investigated. Generally after harvested, roselle calyces have to be processed within 2 to 3 days due to its highly perishability and those which are not processed will need to be chilled or frozen for later processing. Occasionally, foods stored in freezer produce no loss in product weight but can cause a cold shock. Cold shock is acceptable in some products (for example raspberries, shrimps and diced meat), but in many foods the internal stresses created

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by the extremely high rate of freezing cause the food to crack or split (Spiess, 1980). Until now, there are still lack of information and study about the quality and acceptability of roselle products (i.e juice) made from chilled and frozen calyces.

MATERIALS AND METHODS

Sample Preparations

Roselle calyces were harvested from SPK Rhu Tapai, Setiu Terengganu which was cultivated on BRIS soil. The roselle calyces from variety UKMR-2 were decored (where the seeds were removed) and then washed with tap water and air-dried before storage at different cold temperatures. The storage temperatures used were: Chilling temperature: 5±1°C; Freezing temperature: -19±1°C; Freezing temperature: -80±2°C and fresh roselle was used as control. Decored roselle calyces were kept in the respective cold storage for 7 days before taken out and processed to make juice.

Physico-chemical Analyses

Color: The L* a* b* color of each roselle are determine by measuring L* a* b* values at 3 different sites on each roselle. In this experiment, a colorimeter CIE L* a* b* colour space were used measuring the colour of roselles. Lightness value, L*, indicates how dark/light the sample is which are varying from 100 (white) to 0 (black), a* value indicates the redness/green color with values varying from +60 (red) to -60 (green) and b* is the grade of blueness/yellowness which is also varying from +60 (yellow)to -60 (blue).

Ascorbic acid: Ascorbic acid content was determined by using colorimetric technique described by Jagota and Dani (1982). Roselle juice was treated with folin reagent before taking absorbance at 760nm. The amount of ascorbic acid in the roselle juice was then calculated based on the ascorbic acid standard curve.

Anthocyanin: The determination of anthocyanins contents was done by using UV-VIS Spectrophotometry. The absorbance of roselle juice made from roselle stored at different cold storage was measured in pH 1.0 and 4.5 buffers at 520 nm.

Sensory Evaluation

Roselle juice was sweetened with some sugar before served to 30 randomly selected panels for their sensory acceptability. Hedonic scoring was used to determine the sample acceptability, where 7= very much acceptable; 6= moderately acceptable; 5= slightly acceptable; 4= neither acceptable nor unacceptable; 3= slightly unacceptable; 2= moderately unacceptable; 1= very much unacceptable.

Experimental Design and Statistical Analysis

The experiments were carried out according to completely randomized design (CRD). All the analyses parameters were done in 3 replicates for each roselle samples.The data were analyzed using one way analysis of variance (ANOVA) and differences of means among treatments were determined for significant at $P<0.05$ using Tukey multiple comparison test. The statistical software used was SPSS.

RESULTS AND DISCUSSION

Color: The colour of roselle juice showed that the L*a* b* values were different (Figure 1 and Table 1) among different storage temperatures. There was no significant difference ($P>0.05$) for colour L* value (lightness) of juice among all the treatments. However, there were significant differences ($P<0.05$) in a* and b* values for juice colour among treatments at different cold temperatures. For a* value (redness), juice made from fresh roselle showed significantly the highest followed by juice made from roselle stored at 5°C, -80°C and the lowest was -19°C. While for b* value (yellow/blue), juice made from freshroselle also showed significantly the highest followed by 5°C, -80°C and the lowest was -19°C.

Anthocyanins are water soluble so they are found mainly in the cell vacuoles of fruit and vegetables, often in the epidermal layers (Tsai *et al.*, 2002). Freezing causes negligible changes to pigments, flavours or nutritionally important components, although these may be lost in preparation procedures or deteriorate later during frozen storage (Spiess, 1980).

Ascorbic acid: There was no significant differences ($P>0.05$) in the ascorbic acids content among all the treatments (Figure 2 and Table 2). The ascorbic acids content of juices was the highest in juice from fresh roselle (control) followed by -80°C, -19°C and the lowest was roselle juice from 5°C.

Anthocyanin: There was no significant difference ($P>0.05$) for anthocyanins content observed among all the treatments. Figure 3 and Table 3, showed that the anthocyanins content of juices was highest in treatment on fresh roselle (control) followed by 5°C, -19°C and the lowest was from -80°C. The main changes to frozen fruits during storage are occurred the degradation of pigments which changes in pH due to precipitation of salts in concentrated solutions change the colour of anthocyanins (Fennema, 1975). Anthocyanins belong to a class of compounds called flavonoids and have structures derived from the 2-phenylbenzopyrylium (flavylium) salt. Antho-

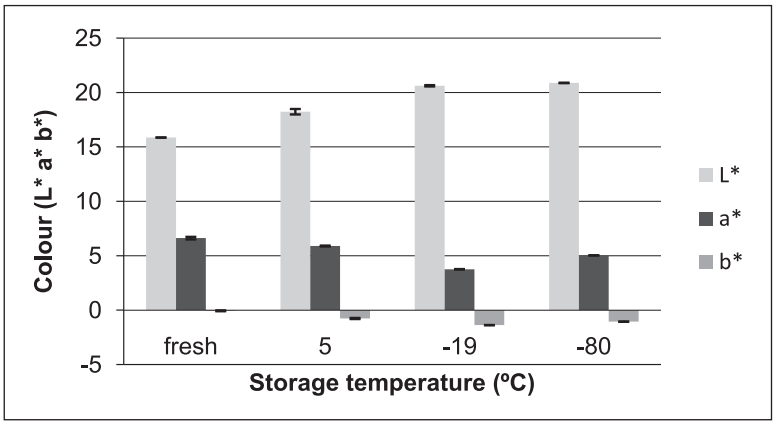

Fig. 1. The colour (L* a* b*) of roselle juice made from roselle calyces stored at different cold storage.

Table 1. The colour (L* a* b*) of roselle juice stored in different cold storage

Treatment (ºC)	Colour		
	L* value	a* value	b* value
Fresh (control)	15.56±0.34^{c}	6.67±O.42^{a}	0.03±0.11^{a}
5±1°C	18.39±0.86^{b}	5.83±0.12^{b}	-0.77±0.16^{b}
-19±1°C	20.51±0.20^{a}	3.72±0.06^{d}	-1.37±0.02^{d}
-80±2°C	20.92±0.05^{a}	5.06±0.01^{c}	-1.05±0.01^{c}

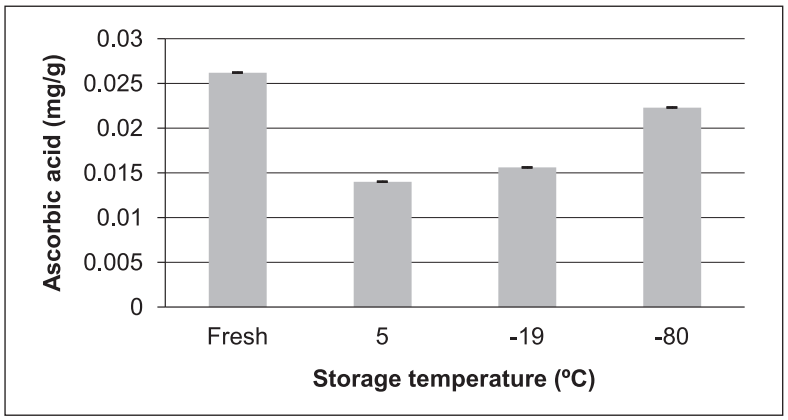

Fig. 2. The ascorbic acid of roselle juice made from roselle calyces stored at different cold storage.

Table 2. The ascorbic acid of roselle juice stored at different cold storage

Treatment	Ascorbic acid (mg/g)
Fresh (control)	0.0262±0.0025^{a}
5±1°C	0.0139±0.0019^{b}
-19±1°C	0.0153±0.0019^{b}
-80±2°C	0.0213±0.0026^{a}

cyanins provide many of the red-purple colours of fruit and vegetables. Anthocyanins are found mainly in the cell vacuoles of fruit and vegetables, often in the epidermal layers. They produce strong colours, which often mask carotenoids and chlorophyll. The colour intensity of anthocyanin pigments is strongly dependent on pH. The colour intensity of a solution containing anthocyanin pigments decreases sharply as the pH is increased from 1 to 5

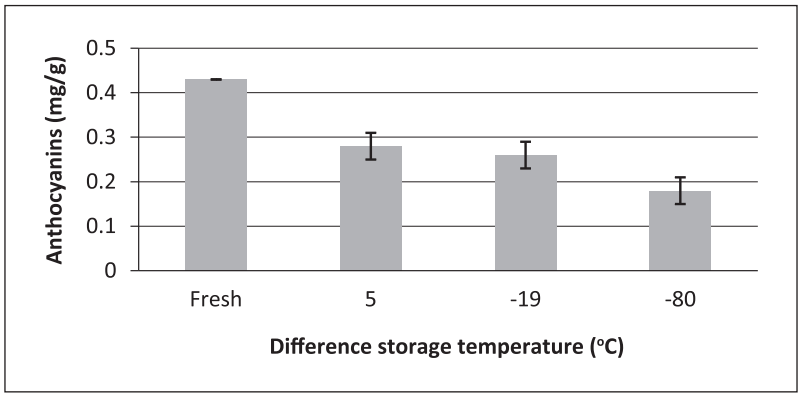

Fig. 3. The anthocyanins content of roselle juice made from roselle calyces stored at different cold storage.

Table 3. The anthocyanins of roselles juicestored at different cold storage

Treatment	Anthocyanins (mg/g)
Fresh (control)	0.43±0.02[a]
5±1°C	0.28±0.01[b]
-19±1°C	0.27±0.01[b]
-80±2°C	0.18±0.01[c]

and this is reversible (Wong *et al.*, 2002; Duangmal *et al.*, 2004).

Sensory Evaluation: The roselle juice and pickle were evaluated for their sensory qualities and general acceptability. Figure 4 showed the sensory analysis of the roselle juice made from roselles stored at temperature of 5°C, -19°C and -80°C. Juice made from fresh roselle showed significantly more acceptable for all the sensory attributes compared to other treatments. It was also observed that the juice made from roselle stored at -80°C showed significantly lower acceptability mainly in the attribute of colour.

CONCLUSION

Roselle juices made from frozen roselles (-19±1°C and -80±2°C) showed significantly higher L* values followed by roselles stored at 5±1°C and fresh roselles. In addition, juice made from fresh roselle had significantly the highest a*, b* values and anthocyanins content followed by roselle stored at 5±1°C and -80±2°C where juice made from roselle stored at -19±1°C showed the lowest values. However, for ascorbic acid content, fresh roselle also showed the highest value followed by roselle stored at -80±2°C, -19±1°C and the lowest was roselle stored at 5±1°C. The sensory evaluation showed that, roselle juice made from fresh calyces was the most acceptable in almost all the attributes compared to chilled and frozen roselles. In conclusion, juice made from fresh roselle had almost all the preferred physico-chemical qualities and sensory acceptability followed by chilled and frozen roselles.

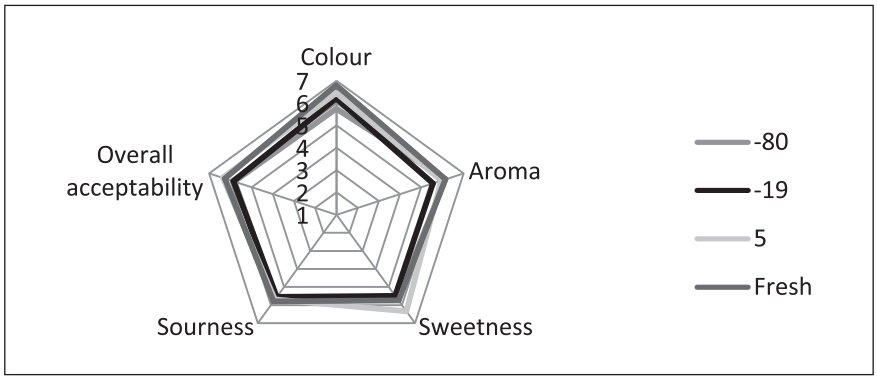

Fig. 4. The sensory acceptability of roselle juice made from roselle calyces stored at different cold storage.

ACKNOWLEDGEMENT

The authors would like to acknowledge all the staff at Postharvest Technology Lab and Plant Research Lab, Department of Agrotechnology, UMT for their commitment and helping hands as well as for the Roselle Special Interest Group (RSIG) UMT.

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