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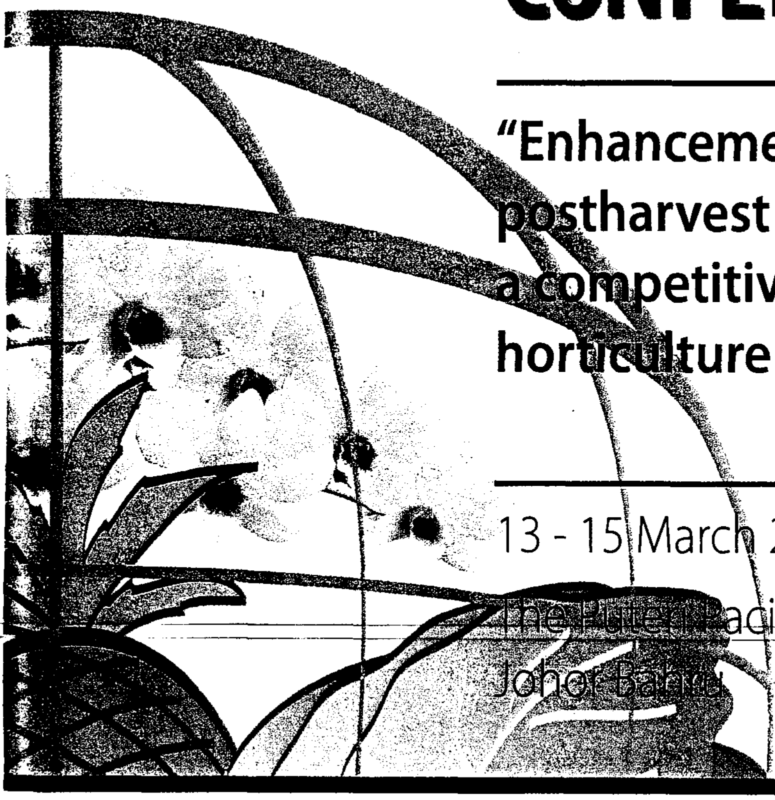

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Quality Characteristics of Arab and Terengganu Roselles

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ABSTRACT

Subjectively Arab and Terengganu roselle (*Hibiscus sabdariffa* L.) are different in terms of size, colour and taste. However, no objective measurement was reported. Therefore, objective measurement was carried out to determine the quality characteristics of Arab and Terengganu roselles. The colour of calyx and epicalyx, soluble solids concentration (SSC), titratable acidity (TA), pH, vitamin C contents and ratio of SSC/TA were determined. There was no significant differences in calyx L* values and malic acid percentage of Arab and Terengganu roselle. The calyx of Arab roselle showed significantly lower C* and h° values as compared to Terengganu roselle. The L*, C* and h° values of Arab roselle epicalyx was significantly lower than Terengganu. This result indicated that the epicalyx colour of Arab roselle is darker, less chroma and reddish-purple as compared to Terengganu. The SSC and SSC to TA ratio of Arab roselle were significantly higher than Terengganu roselle indicating Arab roselle was sweeter and more palatable than Terengganu. The pH value for Arab and Terengganu roselle was 2.62 and 2.68, respectively, where the pH value of Arab was significantly lower than Terengganu. The vitamin C content

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of Arab roselle was significantly higher than Terengganu. In conclusion, the subjective perception of Arab roselle as having sweeter taste, less sour and dark red as compared to Terengganu was not totally correct. The high SSC in Arab roselle renders the sour taste of roselle which actually has significantly lower pH value than Terengganu.

Keywords: calyx, epicalyx, colour, soluble solids concentration, malic acid

INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.) is an annual erect, bushy and herbacaeous shrub. The calyx of roselle consists of 5 large sepals with a collar (epicalyx) of 8 to 12 slim, pointed bracts around the base. Calyx is commonly used to make jellies, jams and beverages. The brilliant red colour and unique flavour make it a valuable food product. The anthocyanin pigments that create the colour (Tsai and Ou, 1996) are responsible for the brilliant red colour. Recently, the biological activities of anthocyanin, such as antioxidant activity, protection from atherosclerosis and anticarcinogenic activity have been investigated (Tsai et al., 2002), and this lead to the popularity of this plant.

In juice processing industry, the calyx and epicalyx are separated from seed pods and heat from simmering will leach out the anthocyanin and nutrients from calyx and epicalyx. There are few 'varieties' of roselle that are available in Malaysia, namely Arab, Terengganu, Johor, Sarawak and Perlis. These 'varieties' vary in size, colour, texture, sweetness and sourness. Subjectively Arab and Terengganu roselles are different in terms of size, colour and taste. It was perceived that Arab roselle has sweeter taste, less sour and dark red as compared to Terengganu. However, no objective measurement was reported. Therefore, objective measurement was carried out to determine the quality characteristics of Arab and Terengganu roselles.

MATERIALS AND METHODS

Plant Materials

Roselle plants were intercropped with banana plants in Ladang 2, Universiti Putra Malaysia (UPM) and the mature 'fruit' of Arab and Terengganu 'varieties' were collected before 1100 hour. The 'fruits' were transported to Postharvest Laboratory, UPM within an hour. Twenty 'fruits' from each 'variety' were selected based on uniformity in size and colour and free from mechanical and insect defects.

Determination of skin colour

Calyx and epicalyx colour was determined using Minolta CR-300 Chroma Meter (Minolta Corp., Japan) using the Illuminate C (CIE, 1976) and results were expressed as lightness (L*), chroma (C*) and hue (h^o). The L* value is ranging from 0 = black to 100 = white. The h^o is an angle in a colour wheel of

360°, with 0°, 90°, 180° and 270° representing the hues red, yellow, green and blue, respectively, while C* is the intensity or purity of the hue.

Determination of soluble solids concentration (SSC)

Ten g of the macerated calyx and epicalyx was homogenised with 40 ml of distilled water by using a kitchen blender. The mixture was filtered with cotton wool. A drop of the filtrate was then placed on the prism glass of refractometer (Model N1, Atago, Japan) to obtain the %SSC. The readings were corrected to a standard temperature of 20 °C by adding 0.28% to obtain %SSC at 27 °C.

Determination of titratable acidity (TA) and pH

The remainder of the juice from the SSC determination was used to measure TA by titrating with 0.1 N NaOH using 1% phenolphthalein as indicator. The results were calculated as a percentage malic acid [(ml NaOH x 0.1 N/weight of sample titrated) x 0.06705 x 100].

The pH of the juice was measured using a glass electrode pH meter model Crison Micro pH 2000 (Crison Instruments, S.A., Barcelona, Spain). The pH meter was calibrated with buffer at pH 4.0 and 7.0 before being used.

Determination of SSC to TA ratio

The data of TA were divided by %SSC to obtain the ratio.

Determination of vitamin C content

Ten g of the macerated calyx and epicalyx was well homogenised with 3% cold metaphosphoric acid. The volume was made up to 100 ml and filtered with cotton wool. Then 5 ml of the aliquot was titrated with 2,6-dichlorophenol-indophenol solution to a pink colour. The vitamin C content was determined according to Ranganna (1977) method.

Statistical Analysis

Data were analyzed statistically using analysis of variance and means differences were determined for significant at $P < 0.05$ using Duncan's multiple range test.

RESULTS AND DISCUSSION

There was no significant differences in calyx L* values of Arab and Terengganu roselles (Table 1). The calyx of Arab roselle showed significantly lower C* and h^{o} values as compared to Terengganu roselle. This indicated that the calyx colour of Arab roselle has similar lightness with Terengganu, but less chroma and more reddish-purple than Terengganu. The L*, C* and h^{o} values of Arab roselle epicalyx was significantly lower than Terengganu. This result indicated that the epicalyx colour of Arab roselle is darker, less chroma and reddish-purple as compared to Terengganu. The differences in colour of calyx and epicalyx Arab and Terengganu roselles could be due to the content of anthocyanin and its polymer.

The SSC of Arab roselle was significantly higher than Terengganu, indicating more soluble material was found in Arab roselle tissues than Terengganu (Table

2). However, no report was found on the major composition of soluble material in roselle. There was no significant difference in percentage malic acid of these two roselle 'varieties'. The SSC to TA ratio in Arab roselle was significantly higher than Terengganu (Table 2). This showed that Arab roselle was sweeter and more palatable than Terengganu. However, the 'fruits' are not suitable for fresh consumption due to its acid flavour and the pH of 'fruit' is less than 3 (Table 2). The pH value for Arab and Terengganu roselles was 2.62 and 2.68, respectively, where the pH value of Arab was significantly lower than Terengganu. The pH depends on the concentration of free H ions or mirrored the changes in total organic acids (Wills et al., 1998). The free state of H ions is due to dissociation of H ion from the carboxylic group (-COOH) of organic acids. This increase in pH throughout maturation was due to a metabolic process in the 'fruits' that resulted in the decrease of organic acids. This is because organic acids are an important source of respiratory energy in plant cells. From Table 2, it is apparent that low TA in Arab roselle was associated with low pH and vice versa in Terengganu roselle. Furthermore, the vitamin C content of Arab roselle was significantly higher than Terengganu.

CONCLUSION

In conclusion, the objective measurement between Arab and Terengganu roselles showed that the subjective perception of Arab roselle with sweeter taste, less sour and dark red as compared to Terengganu was not totally correct. Further study will be conducted to profile and quantify the anthocyanin pigments in order to reveal the cause of colour differences in these two 'varieties'.

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Table 1: Colour (L*, C* and h°) of Terengganu and Arab roselle calyx and epicalyx.

	Calyx			Epicalyx		
	L*	C*	h°	L*	C*	h°
Arab	28.35	10.34	360.67	20.09	4.61	336.62
Terengganu	28.57	15.92	366.74	29.66	13.13	366.54
F-significant	NS	**	**	**	**	**

**, NS Highly or non significant at $P < 0.05$.

Table 2: Soluble solids concentration (SSC), titratable acidity (TA), SSC to TA ratio, pH and vitamin C of Terengganu and Arab roselle.

	SSC (%SSC)	Titratable acidity (% malic acid)	SSC/TA ratio	pH	Vitamin C (mg 100 g^{-1})
Arab	7.86	2.23	3.52	2.62	20.76
Terengganu	5.96	2.30	2.59	2.68	15.89
F-significant	*	NS	*	*	*

*, NS Significant or non significant at $P < 0.05$.

P4-5

Physico-chemical changes of Maspine pineapple after low temperature storage

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Pineapple of Maspine variety from MARDI Pontian germplasm was harvested at breaker stage and transported to MARDI's Postharvest Laboratory at Serdang. The fruits were then stored at 8°C for 3 weeks. Fruits were removed from the cold room after 3 weeks and held at ambient temperature (25°C) for another 7 days. Development of black heart disorder was observed in fruits on removal and during subsequent days at ambient temperature. The chemical changes on total soluble solid (TSS), titratable acidity (TTA), vitamin C (ascorbic acid), pH and total sugar were also analysed using the flesh of the fruits. The development of blackheart symptoms at removal indicates that the fruit is highly susceptible to this physiological disorder. Expression of blackheart symptoms was more pronounced when the fruits were exposed to ambient temperature. There were some chemical changes observed during low temperature storage and after being transferred to ambient temperature. The fruits exhibited an increase in pH values and TSS but decreased in TTA, ascorbic acid and total sugar. This study provides valuable information for future research to further extending storage life of this pineapple variety.

P4-6

1-methylcyclopropene improves quality of stored carambola

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Carambola cv. B10 at colour index (CI) 3 to 4 were exposed to 1-methylcyclopropene (1-MCP) at concentrations of 0, 400, 800 and 1200 nl/l for 8 hours at 25°C. The fruits were then stored at 7°C for up to 7 weeks. The stored fruits were removed after 4, 5, and 7 weeks from low temperature storage and held further for 7 days at ambient (25°C). The study showed that fruit exposure to 1-MCP of 400 and 800 nl/l at pre-storage caused a delay in quality deterioration which took place during and after low temperature storage. Surface yellowing and flesh softening were slower in the 1-MCP-treated fruits as compared to the control. Treated fruits remained firm with minimal browning of the ribs occurred after 6 weeks storage at 7°C when the control had already shown signs of deterioration. Evaluations on stored fruits were also conducted on total soluble solids (TSS), total titratable acidity (TTA), pH and ascorbic acid.

P4-7

Storage quality of starfruit harvested at advanced maturity stage

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A study was conducted to evaluate the effect of advanced harvest maturity on quality of starfruit during storage. The fruits were harvested at colour index 4, a more advance stage with about 50% of fruit surface had turned to yellow and at colour index 2 (fruit colour is light green with tinge of yellow), a commercial maturity stage, as a control. Fruits were subjected to low temperature storage at 8°C and the quality of the fruits was evaluated weekly up to 10 weeks. Fruits harvested at advanced stage of maturity, showed better physical characteristics, chemical compositions and sensory quality as compared to those harvested at commercial stage. The fruits of advanced stage were also able to tolerate low temperature storage and can be kept for up to 8 weeks at 8°C.

P4-8

Quality characteristic of Arab and Terengganu roselle

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Subjectively Arab and Terengganu Roselle *(Hibiscus sabdariffa* L*)*. are different in terms of size, colour and taste. However, no objective measurement was reported. Therefore, objective measurement was carried out to

determine the quality characteristics of Arab and Terengganu roselle. The colour of calyx and epicalyx, soluble solids concentration (SSC), titratable acidity (TA), pH, vitamin C contents and ratio of SSC/TA were determined. There was no significant differences in calyx L* values and citric acid percentage of Arab and Terengganu roselle. The L*, C* and h° values of calyx and epicalyx of Arab roselle were different while no colour differences was noticed in Terengganu roselle. The calyx of Arab roselle showed significant lower of C* and h° values as compared to Terengganu roselle. The L*, C* and h° values of Arab roselle epicalyx were significantly lower than Terengganu roselle. This result indicated that the epicalyx colour of Arab roselle is darker, less chroma and reddish-purple as compared to Terengganu roselle. The SSC and SSC to TA ratios of Arab roselle were significantly higher than Terengganu roselle indicating Arab roselle was sweeter and more palatable than Terengganu roselle. The pH values for Arab and Terengganu roselle were 2.62 and 2.68, respectively, where the pH value of Arab was significantly lower than Terengganu. The vitamin C content of Arab roselle was significantly higher than Terengganu roselle. In conclusion, the subjective perception of Arab roselle with sweeter taste, less sour and dark red as compared to Terengganu roselle was totally correct. The high SSC in Arab roselle renders the sour taste of roselle which actually has significantly lower pH value than Terengganu roselle.

P4-9

Fruit quality characteristics of mangosteen (*Garcinia mangostana* L.) in MARDI Bukit Tangga Research Station.

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Fruit quality characteristics of mangosteen (*Garcinia mangostana* L.) at MARDI Bukit Tangga Research Station Kedah were studied. About 300 fruit samples have been harvested and evaluated every fruiting season for over three years (2004 until 2006). The fruits were harvested at maturity stage 4 by using a colour ranking index as recommended by MARDI. The parameters studied were fruit and skin weight, skin thickness, number of segmen, number of seed, gummosis scoring and total soluble solids (TSS%). Results showed that fruit weight and number of seed in year 2004 were significantly higher than other year. However, for skin weight, skin thickness, number of segmen and gummosis scoring in year 2006 showed significantly higher than previous year. For Total Soluble Solids (TSS %), the highest value was recorded in year 2005. In conclusion, fruit quality characteristics of this fruit showed various trend among the year studied. More detailed studied on these aspects are critically needed to have a high fruit quality of this potential fruit for fresh consumption and export markets.

5. Food Science and Technology

P5-1

Processing of mango

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Mango (*Mangifera indica,* L.) is one of the most delicious fruits of the tropics, and it is considered by many to be the best fruit in the world market due to its excellent flavour and taste. The composition of mango fruit varies with the cultivar, cultural and climatic conditions, and stage of maturity and storage of the fruit. Young mango fruits are astringent, acidic and rich in vitamin C, whereas ripe mangoes are sweet, rich in carotenoids, moderate in vitamin C and highly aromatic. Mangoes are usually eaten fresh as dessert but they can be processed at both green and ripe stages of maturity into various products. Fully ripe, but firm and evenly matured mangoes are usually selected for processing as they have strong flavour, better colour and higher product yield. There has been some work done so far in MARDI regarding the utilization of mango. Mango can be processed into products such as puree, juice, nectar, squash, cordial, syrup, beverages, jam, confectionery jelly canned in syrup, fruit roll/leather, sweet sour salty products, dehydrated candied, pickle, chutney, sauce and powder. This paper will highlight some of the potential products from ripe and green mango and their processing techniques.

P4-10

Physico-chemical quality characteristics of red pitaya *(Hylocereus polyrhizus)* after postharvest treatment with 1-MCP

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In this study, the effect of 1-MCP on physico-chemical changes of red pitaya during storage at 10 °C were determined. Fruits harvested at 30 days after anthesis were treated with 1-MCP (0,500, and 1000 nL/L) for 4 h and stored at 10 °C. Changes in fruit colour, firmness, soluble solids concentration (SSC) and titratable acidity (TA) were monitored at 0,7, 14, 21 aand 28 days of storage. There were significant changes in peel L*, C* and h° values of cotnrol and 1000 nL/L 1-MCP-treated fruits. However, there were no significant relationships between peel L*, C* and h° values with storage duration in 500 nL/L 1-MCP-treated fruits indicating that 500 nL/L 1-MCP maintained peel colour of fruit. Fruit-scale values of L* and C* for control fruits showed significant changes whereby the scales turned darker during storage. There were no significant changes in L*, C* and h° values of fruit scales treated with 500 a nd 1000 nL/L of 1-MCP, SSC and TA of control fruit showed negative quadratic relationships with storage duration while a negative linear change occurred in firmness. However, there were no significant effects of storage duration on firmness, SSC and TA of fruits treated with 1-MCP. These indicated that quality of red pitaya treated with 500 and 1000 nL/L of 1-MCP were maintained during 28 days of storage. It appeared that fruit peel and scale colour and physico-chemical quality characteristic were maintained in fruits treated with 500 nL/L of 1-MCP

P4-11

Kesan pembungkusan dan jangkamasa penyimpanan terhadap kualiti lepas tuai serai 'Galah' (*Cymbopogon citratus*)

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Kesan tiga kaedah pembungkusan dengan enam jangkamasa penyimpanan terhadap kualiti dan kandungan pigmen antosianin serai 'Galah' telah dikaji. Serai gred eksport dibungkus dalam kotak kertas sahaja, kotak kertas dibungkus plastik putih (KPPP), kotak kertas dibungkus plastik hitam (KPPH) dan disimpan pada 10 °C. Ciri-ciri kualiti batang serai (kehilangan air, warna, kekerasan, kepekatan pepejal terlarut (KPT), pH, keasidan tertitrat (KT), kandungan asid askorbik (KAA) dan kandungan antosianin (KA) dianalisis setiap tiga hari sekali selama 5 hari. Terdapat kesan interaksi di antara kaedah pembungkusan dan jangka masa penyimpanan terhadap kehilangan air, kekerasan, KAA dan KA dalam batang serai. Kehilangan air bagi serai yang disimpan dalam kawalan, KPPP dan KPPH masing-masih adalah 28%, 13% dan 2%. Kekerasan serai menurun sebanyak 93% pada hari ke-15 berbanding hari sifar bagi kawalan, 66% pada KPPP dan 35% pada KPPH. Rawatan KPPH mengekalkan KAA lebih tiga hari berbanding rawatan kawalan dan KPPP. Pigmentasi kemerahan yang disebabkan oleh KA pada batang serai dalam KPPH adalah lebih 47% pada hari ke-15 berbanding hari ke-12 dan pigmentasi kemerahan mula kelihatan selepas 9 hari penyimpanan. Bagi kawalan 78% pigmentasi kemerahan mula kelihatan pada hari-3 penyimpanan. Bagi rawatan KPPP pula, pigmentasi kemerahan mula terbentuk pada hari ke-6 penyimpanan dan mencatatkan lebih 60% pada hari ke-15 berbanding hari ke-6 penyimpanan. Bagi KPT, pH dan KT masing-masing tidak menunjukkan kesan interaksi di antara kaedah pembungkusan x jangka masa p enyimpanan. Kepekatan pepejal larut, pH dan KT menunjukkan penurunan nilai dari hari sifar sehingga hari ke -15 penyimpanan. Pembungkusan serai dalam kotak kertas dibalut plastik hitam dapat menghalang pigmentasi kemerahan antosianin dalam batang serai sehingga hari kesembilan penyimpanan.