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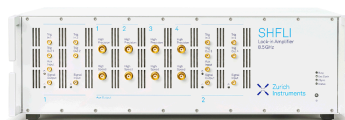
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The Distribution of Main Internal Quality in Pummelo (*Citrus grandis*) Fruit

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Abstract. This study is aim to explore the distribution of main internal quality among different parts of pummelo fruit. Four pummelo cultivars, 'Sanhong Miyou', 'Hongrou Miyou', 'Huangjin Miyou' and 'Hongmian Miyou' were used as materials. The total soluble solids (TSS), total sugar and titratable acid contents among different parts of the fruit were analyzed. The distribution of main internal quality revealed consistent pattern in colorized pummelo fruit from different genotypes and ecological climate zones. TSS and total sugar contents were significantly higher in the top of the fruit and the middle part of the fruit than that in the base. The TSS content in the middle part near the column has the maximum correlation with the TSS content in whole fruit. There were no significant differences in titratable acid distribution among different parts of fruit. The TSS content in the middle part near the column can represent the whole fruit's content. Different genotypes and ecological climate zones had no effects on the distribution of main fruit internal quality.

INTRODUCTION

Pummelo (*Citrus grandis* L. Osbeck), belonging to the genus *Citrus* of the family Rutaceae, is one of the three basic species of citrus cultivars, which account for approximately 24% of the output of Citrus in China [1]. Previous studies mainly used random sampling to measure the citrus quality. Because the pummelo fruit is large, there are great differences of fruit quality among different parts [2, 3]. It is necessary to investigate the discipline of the quality distribution in pummelo fruit. The content of soluble solids among different parts was demonstrated to be different. This was also consistent with that in grape [4] and sweet carambola [5]. Soluble solids, total sugar and titratable acid are the most important inherent qualities of pummelo, while the distribution in colored pummelo has not been reported.

The contents of soluble solids, total sugar and titratable acid among different parts of the fruits of sweet pummelo varieties planted extensively in Sichuan Basin were determined and analyzed. Our objectives are (i) to explore the main internal quality distribution of pummelo fruit to find out the specific parts that can directly represent the whole fruit content; (ii) to analyze whether genetic types and eco-climatic regions have an impact on the main internal quality distribution of pummelo fruit or not.

MATERIALS AND METHODS

Plant Materials

Here we selected 'Sanhong miyou', 'Hongrou miyou', 'Huangjin miyou' and 'Hongmian miyou' mutated from 'Guanxi miyou' as materials. Ten fruits per variety were analyzed, with concurrent characteristics of shape, appearance and endoplasm.

Test Method

Based on the unique anatomical structure of *Citrus* (Figure 1a) and sugar transport rule [6-7], the flesh of each capsule is divided into four parts (Figure 1b). They are (1) base of fruit, (2) middle near-middle column, (3) middle far-middle column, and (4) top of the fruit. Taking single fruit as a unit, the juice was squeezed from four parts separately, placed in the triangle bottle, and sealed with sealing film. Digital display sugar detector was used to analyze the soluble solids, total sugar, and titratable acid were determined by digital display sugar detector, Phillin method, and acid-base neutralization titration method, respectively.

Data Analysis

All the data in this study were expressed as means \pm standard deviation. The data were analyzed using Excel 2010 and SPSS 20, and Duncan multiple range tests at 5% significant level.

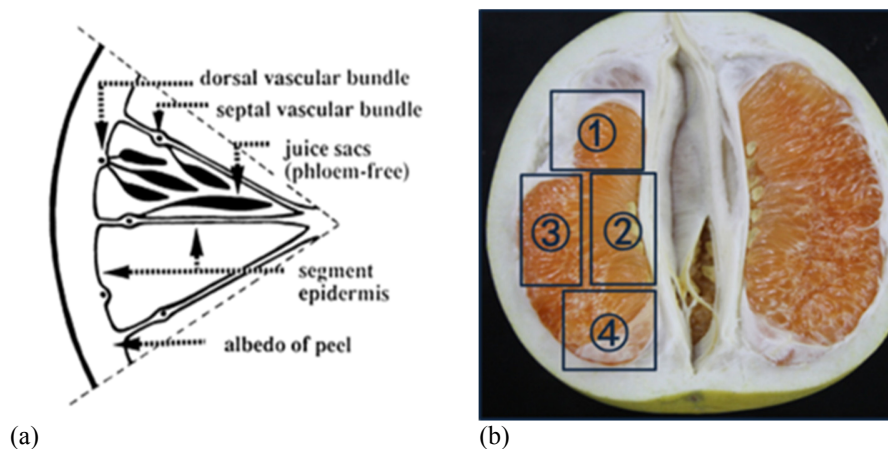


FIGURE 1. Transection diagram of citrus fruit (a) and part division diagram of pummelo fruit (b).

RESULTS

Distribution of Main Internal Qualities of Four Pummelo Cultivars in Fruits

In order to explore the distribution of the main internal quality of four colored pummelo cultivars, the total soluble solids, total sugar and titratable acid among different parts of the fruits were determined (Table 1). The results showed that the fruit quality distribution of different genotypes showed a consistent pattern. The contents of soluble solids and total sugar among different parts was demonstrated to be different. In the top of the fruit, the middle near-middle column of the fruit and middle far-middle column of the fruit of four colored pummelo varieties, the content of TSS and total sugar was significantly higher than that in the base of the fruit. There was no significant difference in titratable acid content among different parts.

Correlation analysis showed that the TSS content in the middle near-middle column of fruit has the maximum correlated with the TSS content in whole fruit ($r=0.910$, $y=1.903+0.910x$, $R^2=0.827$).

Distribution of Main Internal Qualities of Pummelo in the Ecological Climatic Area

As shown in Figure 3, there was no significant difference in titratable acid content among different parts (Figure 3a). The content of TSS and total sugar in the top of the fruit was significantly higher than that in the other parts of the fruit (Figure 3b and 3c). This was consistent with that in other three pummelo cultivars.

TABLE 1. Internal quality of different pummelo varieties

| Index | Variety | Parts of Fruit | | | |
|---|------------------|----------------|---------------------------|--------------------------|------------------|
| | | Base of Fruit | Middle near-middle Column | Middle far-middle Column | Top of the Fruit |
| Total Soluble Solids (TSS, %) | 'Sanhong Miyou' | 8.56±0.51b | 9.62±0.59a | 9.63±0.56a | 9.57±0.81a |
| | 'Hongrou Miyou' | 8.44±0.80b | 9.22±0.67a | 9.38±0.67a | 9.59±0.55a |
| Total Sugar (g·100 ml ⁻¹) | 'Huangjin Miyou' | 7.58±0.55c | 8.22±0.50b | 8.87±0.59a | 8.53±0.60ab |
| | 'Hongmian Miyou' | 8.99±1.04b | 10.60±1.17a | 9.99±0.76ab | 10.60±1.15a |
| | 'Sanhong Miyou' | 6.06±0.45b | 7.12±0.32a | 7.13±0.26a | 7.07±0.41a |
| | 'Hongrou Miyou' | 6.19±0.52b | 6.88±0.51a | 7.00±0.65a | 7.22±0.40 |
| Titratable Acid (g·100 ml ⁻¹) | 'Huangjin Miyou' | 5.10±0.41b | 5.73±0.53a | 6.10±0.26 | 6.03±0.34a |
| | 'Hongmian Miyou' | 6.66±0.54b | 8.71±0.27a | 7.85±0.63ab | 8.70±0.41a |
| | 'Sanhong Miyou' | 0.86±0.06a | 0.87±0.06a | 0.83±0.09a | 0.83±0.07a |
| | 'Hongrou Miyou' | 0.78±0.14a | 0.76±0.12a | 0.76±0.09a | 0.77±0.11a |
| | 'Huangjin Miyou' | 0.58±0.08a | 0.55±0.09a | 0.58±0.08a | 0.57±0.07a |
| | 'Hongmian Miyou' | 0.85±0.13a | 0.91±0.14a | 0.81±0.12a | 0.84±0.12a |

Note: Data expressed as mean ± SD of triplicate assays. Different letters in the same column indicate statistically significant difference at $P < 0.05$.

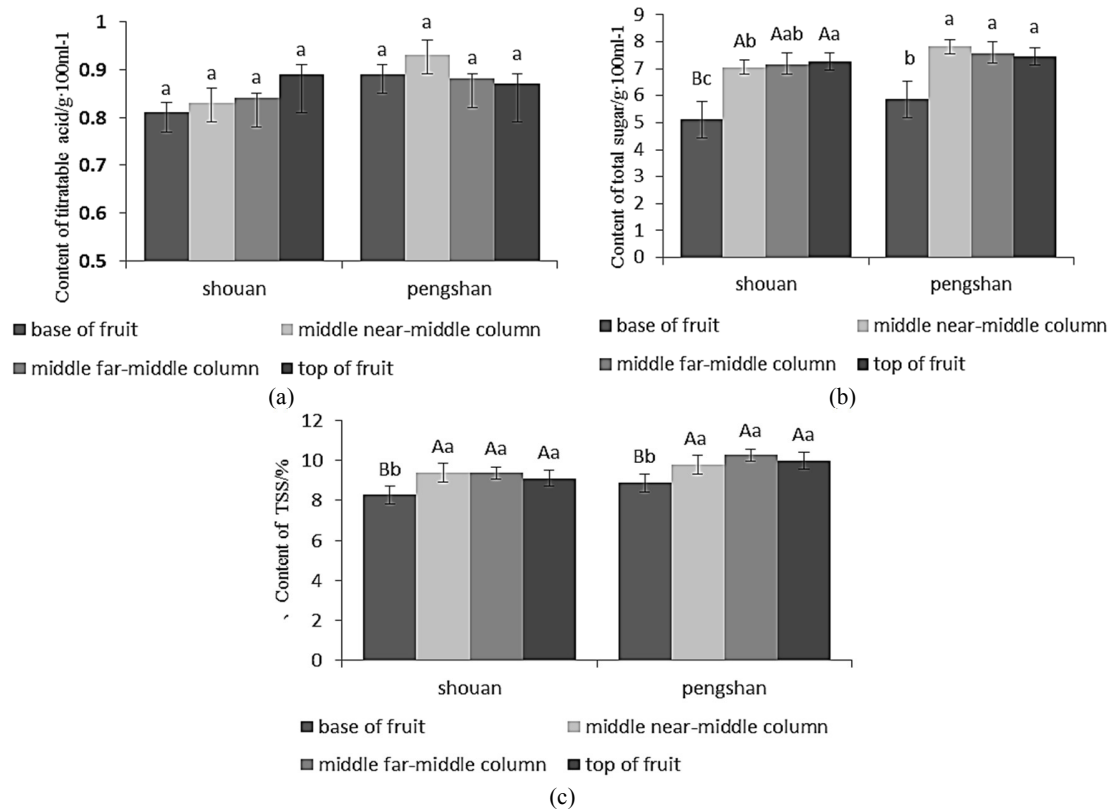


FIGURE 2. The content of titratable acid (a), total sugar (b) and TSS (c) among different parts in 'Sanhong miyou'.

DISCUSSION

Intrinsic fruit quality is an important index to evaluate the commodity of fruit. This study was the first to systematically studying the distribution of main intrinsic fruit quality of four colored pommelo cultivars planted in Sichuan Basin. The results showed that there were significant differences in the internal quality of pommelo fruits. The TSS content in the middle part near the column has the maximum correlation with the TSS content in whole fruit so the TSS content in the flesh middle near-the middle column could represent the TSS content in the whole fruit. Therefore, the content of TSS in the flesh of the middle near-middle column can represent the TSS content of the whole fruit. At the same time, genotypes and different ecological climatic conditions had no significant effect on the quality distribution of pommelo fruit, which was different from the results of grape ^[4].

CONCLUSION

Through the analysis of the main internal quality of the four varieties of pommelo fruit, the correlation equation was established. The TSS content in the middle near-middle column of the fruit can represent the TSS content of the whole fruit. By comparing the fruit quality distribution between different genotypes and different eco-climatic regions, the results showed that genotypes and climatic factors had no effect on the fruit quality distribution.

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