Study on Aroma Compounds during Growth and Development of Berries in Table Grape Cultivars

（生食用ブドウ品種の果実発育と発達における香気成分に関する研究）

Summary

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Summary

Aroma is one of the important indexes to evaluate grape quality. The study on the factors affecting grape aroma is important to cultivate new grape varieties and to understand the mechanisms of fruit aroma formation. In this thesis, aroma profiles during fruit development were compared by using three popular grape cultivars in Japan, namely, 'Kyoho', 'Shine-Muscat', and 'Ryuho', then effects of plant growth regulators (PGRs) on aroma profiles of 'Kyoho' grapes were investigated. Moreover, aroma profiles of different organs and tissues were compared to understand the capacity of aroma production. To obtain the aroma profiles, headspace solid phase microextraction-gas chromatography mass spectrometry (SPME-GC-MS) was used, and the results were analyzed by principal component analysis (PCA). The specific results were as follows:

1. 'Kyoho' and 'Shine Muscat' are the most popular table grape varieties in the world. 'Ryuho' grape is one of the third generation of 'Kyoho' grape with special aroma. In this experiment, the three grape varieties were used as materials. Through the detection of fruit quality and aroma compounds in different growth and development periods, the changes and differences in aroma compounds of the three grape varieties were analyzed. The results shown that the aroma contents of the three grape varieties were different in the whole growth period. The typical aroma compounds of 'Shine-Muscat' were terpenes and C_6 aldehydes, such as linalool and (*Z*)-3-hexenal, respectively. The main aroma compounds of 'Kyoho' and 'Ryuho' grapes are C_6 aldehydes and esters, such as (*E*)-2-hexenal and ethyl acetate. Although 'Ryuho' is the hybrid offspring of 'Kyoho', the content of esters, such as ethyl hexanoate in 'Ryuho' is significantly higher than that in 'Kyoho' grapes. The total content of aroma compounds in 'Shine Muscat' and 'Kyoho' grape gradually accumulated with the growth and development. However, the total content of aroma compounds in 'Ryuho' grape reached the maximum before the ripening period, and then decreased.

2. In order to understand the effects of PGRs on the aroma compounds of ‘Kyoho’ berries, the effects of gibberellin A3 (GA_3) treatment at flowering time, and abscisic acid (ABA) treatment at veraison on the fruit quality and aroma compounds at different growth and development stages were studied. The results shown that 30 compounds were mainly identified in skin and flesh. In the berries treated with GA_3 in the early stage of growth and development, total contents of the aroma compounds were clearly lower than those of untreated fruits. In addition, the content of C_6 compounds in the later stage was higher in GA_3 treatment berries. It was suggested that GA_3 treatment inhibit the synthesis of esters and terpenes and promote the synthesis of C_6 compounds in the later stage of growth and development. And GA_3 inhibited the synthesis of esters and terpenoids such as ethyl acetate, ethyl butyrate and limonene, and promoted the synthesis of C_6 compounds (*Z*)-3-hexenal and (*E*)-2-hexenal in skin. From the results of ABA treatment, ABA would promote the synthesis of most aroma compounds in skin and flesh except C_6 compounds, especially ethyl acetate and ethanol.

3. In order to study the capacity of aroma production of aroma, aroma compounds of different organs of ‘Kyoho’ wine, such as young leaves, old leaves, tendrils, flower buds, flower, fruit 10 days after full blossom (DAFB), skin and flesh of 70 DAFB and 110 DAFB and seeds were analyzed. The results shown that the aroma composition of young leaves and mature leaves were cluster together, and the aroma compounds of tendrils and flower buds were cluster together. Among all organs, the kinds of aroma compounds in flowers were the most, including, (*E*)-2-hexen-1-ol, 1-hexanol, 2-phenylethanol, (*Z*)-2-heptenal, methyl arachidonate, *β*-ionone. The contents of C_6 compounds and aldehydes in the leaves of cubebene were high, including pentanal, (*E*)-2-pentanal, benzaldehyde, ethylbenzene, (*Z*)-3-hexenal, (*E*,*E*)-2,4-hexadienal, (*E*)-2-hexenal. The aroma compounds in seeds were the lowest, mainly including ethyl acetate (*E*,*E*)-2,4-hexadienal, (*E*)-2-hexenal, etc.

The aroma synthesis of table grapes is affected by varieties and plant growth regulators. There are differences in aroma components and contents in different organs and tissues and berries at

different growth and development stages. Further research is needed to understand the regulatory mechanism of various factors.