

## 学位論文要旨

### Plant Growth, Fruit Quality Analysis and Consumer Evaluation of Blueberry Grown in an Advanced Plant Factory

先進植物工場で栽培したブルーベリーの成育と果実品質の解析および消費者評価

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Nowadays, blueberries have been recognized as one of the foremost health fruits around the world. In Japan, blueberry growing area and production have been increased rapidly from about 1995 due to the increased demand of Japanese consumers who are eating blueberries for their health benefits. In the open field production, the harvest duration of blueberry fruits in Japan is limited from June to September (only four months) from all suitable elevations by use of a range of species. Due to the efforts of some blueberry farmers by heating culture in plastic houses, some blueberries could be harvested in May. However, self-sufficiency is still lacking within the country and blueberries are needed to import every year (Ministry of Agriculture Statistics, 2011). In 2011, to upgrade the recent blueberry production, an advanced blueberry factory was established in Tokyo University of Agriculture and Technology (TUAT) as the very first factory to grow a fruit tree in a controlled environment under four seasons (Ogiwara and Arie, 2010). From the attempts of off-season production and continuous harvesting of some cultivars of southern highbush blueberries, the results showed that it was possible to produce off-season fruits in a controlled environment (Ogiwara et al., 2014).

This study was carried out in a controlled environment under two different growing conditions in the TUAT blueberry factory and determinations on characteristics of plant growth and fruit quality analysis in Chapter 2, fruit quality changes throughout the year to evaluate fruit quality in Chapter 3, questionnaire survey on eating quality test of the factory produced fruits in Chapter 4 and

consumers' opinion of the fruit tree factory in Chapter 5 were carried out, and the possible constraints of the fruit production in the plant factory were discussed.

First of all, a comparative study of one northern highbush and two southern highbush blueberries for growth characteristics, photosynthetic potential and fruit quality analysis was carried out. The results showed that normal fruits were developed in all the tested cultivars by successful growth without decreasing any plant vigour and leaf photosynthetic ability until fruit harvesting time. Moreover, it was confirmed that fruit quality was high in some cultivars with high soluble solids content and high anthocyanin content but low acid amount under artificial light growing condition (Chapter 2).

Moreover, fruits which could be continuously harvested throughout the year were investigated for quality analysis. The results showed that fruit quality was different depending on growing condition and the cultivar; fruit quality of 'Misty' was constantly high but the quality of 'Sharpblue' was changing in controlled room. From this finding, it is essential to choose a suitable cultivar like 'Misty' for sustainable year-round production of high quality fruit (Chapter 3).

As a next step, blueberry fruits produced from TUAT factory in winter season were offered to make a comparative study between instrumental analysis of various tastes and panelists' score for visual, textural and taste etc. The results showed that there were sensory and instrumental relationships on sweetness, sourness and appearance. In addition, instrumental and sensory quality characteristics determined blueberry fruits from TUAT factory were high in quality. Based on this finding, a questionnaire survey was carried out to 100 participants (50 in winter season and 50 in summer season) in order to estimate market potential and consumers' acceptability of blueberry fruits produced from the TUAT factory. Delightfully, all participants accepted factory produced blueberry fruits and then the eating quality results showed that fruits produced under artificial light were sweeter, less sour and tastier (Chapter 4).

Finally, an extensive internet survey for consumers' opinions and expectations for the fruit tree factory was carried out working together with a Japan research center throughout the country. Total number of 1,318 women participants of different ages (20 to 69 years old) living in different regions (Hokkaido, Tohoku and Kanto etc.) was participated in the survey. The survey results showed that over 80% of participants accepted factory produced fruits. Moreover, the reason of acceptance was to produce fruits with 'safe and security', 'high quality', 'pesticide-free' and 'low price' etc. for factory produced fruits (Chapter 5).

In conclusion, a fruit tree factory will be realized in future if it is possible to produce year-round with 'high yield', 'high quality', 'safe' and 'security' fruits constantly by choosing suitable cultivars.