

Ministry-led open innovation initiative
"Field for Knowledge Integration and Innovation (FKII)"



**The development of shipping container
maintaining high levels of food quality
through interdisciplinary & industry-academia collaboration**

**Kyushu University
Faculty of Agriculture
Assistant Professor**

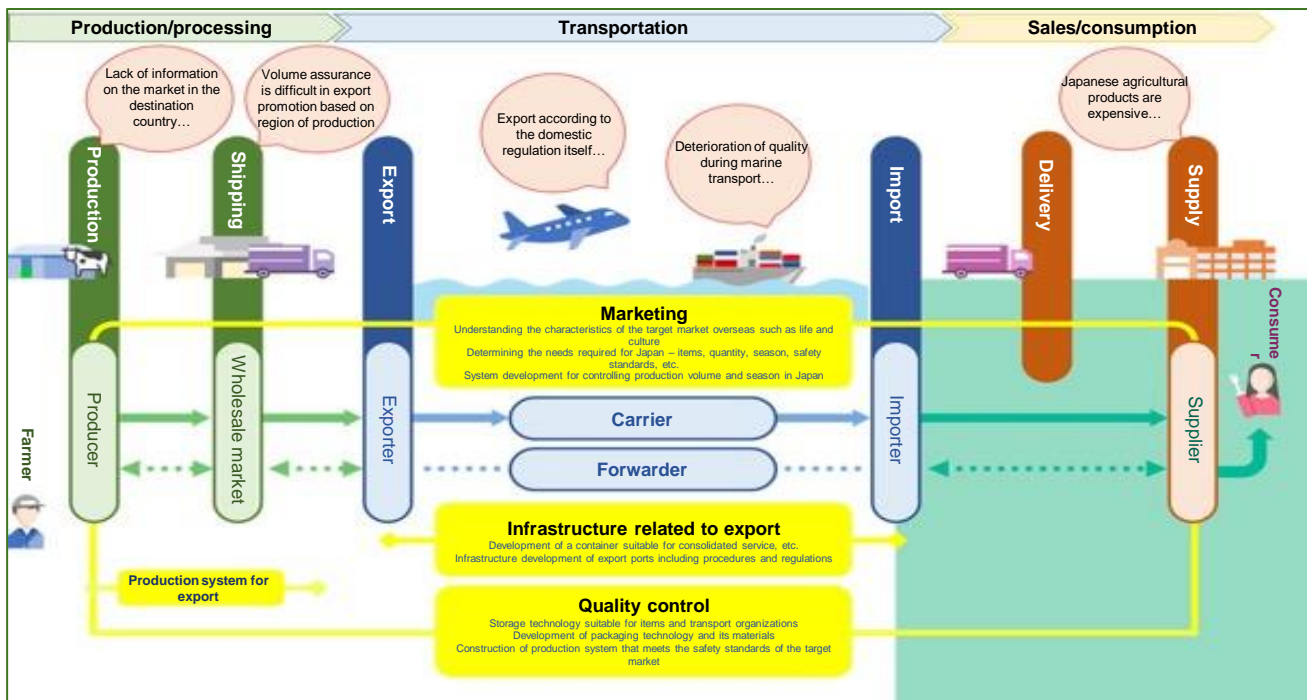
Dr. HyunJung BANG



R&D Platform for Promoting the Export of Agricultural, Forestry, and Fisheries Products at Kyushu-Okinawa



Key concept



Vision and Mission

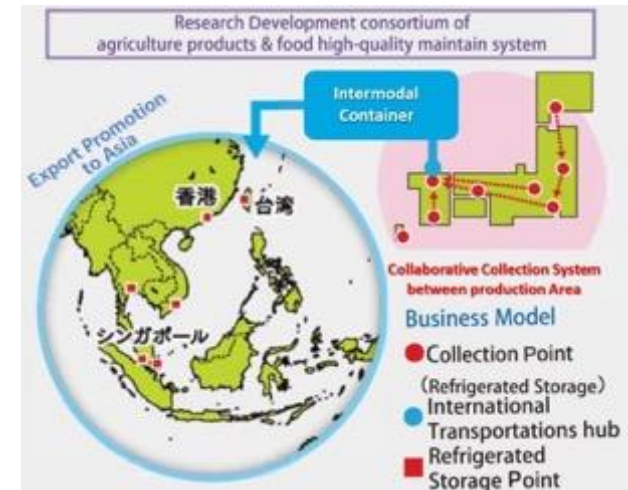
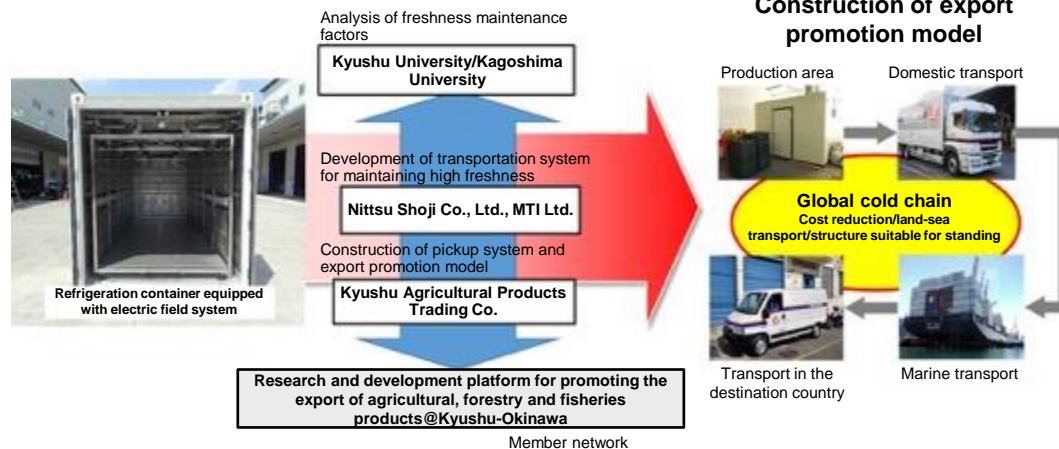
(Vision)

Contribute to increasing agricultural income by promoting the export of agricultural, forestry, and fisheries products.

(Mission)

- ◆ Contribute to realizing high quality and low-cost logistic system through R&D of a new transportation system.
- ◆ Try construction of export models through cooperation between production areas.
- ◆ Suggest the production/export models structure corresponding to the market needs of export destination countries.

Consortium for R&D of Systems to Maintain High Quality Agricultural Products



◆ Planning of R&D project for solving issues and supporting research promotion

- Research and Development of Systems to Maintain high quality of agricultural products
- MAFF R&D model project according to FKII (2016 - 2019)

(1) To elucidate the factors maintaining high quality (freshness) under the electric field environment

(Organizations in charge: Kyushu University, Kagoshima University, Kyushu Agricultural Products Trading Co.,Ltd., MTI Co., Ltd., Nittsu Shoji Co., Ltd.)

(2) Development of an electric field system capable of supporting the construction of a global cold chain

(Organizations in charge: Nittsu Shoji Co., Ltd., Kyushu University, MTI Co., Ltd.)

(3) Construction of an international logistics model for maintaining high freshness of agricultural products

(Organizations in charge: Nittsu Shoji Co., Ltd., MTI Co., Ltd., Kyushu Agricultural Products Trading Co.,Ltd.)

Consortium for R&D of Systems to Maintain High Quality Agricultural Products

Industry's Needs

- To clarify why the electric field keeps the quality of fruits and vegetables and other agricultural products.

Strategies; Innovative Points

- to focus on the **physiological response of plants** and its analysis methods to elucidate the factors for maintaining the quality (freshness).
 - Develop next-generation transport container for fresh products having both **non-thermal electric field technology** and cool air control technology
 - Explore freshness evaluation index based on the physiological response of plants under the electric field environment



<Comparison with other technologies>

Electric field type reefer container with **non-thermoelectric field technology**

A high quality (freshness) maintaining container introduces non-thermoelectric field technology into a reefer container for shipping transportation. It is under development by Nittsu Shoji Co., Ltd. and has a track record of overseas transportation tests. The non-thermoelectric field technology was developed by MARS Company Co., Ltd. and is licensed by Nittsu Shoji Co., Ltd. (Patent No. 5964989 / Electric field application method).

	Quality maintaining (Agricultural products)	Quality maintaining (Marine / Livestock products)	Transportation condition setting	Handling
Electric field reefer container	◎ Suitable for a wide range of fruits and vegetables	◎ Demonstrates quality maintaining and aging effects. Suitable for long- term transportation	△ Transport conditions have not been acquired (conditions are examined in this project)	△ Just install a simple electric field unit. Evaluation of maintainability is carried out in this project
CA Container	○ Suitable for products with high respiratory volume	× Not compatible (fresh food only)	△ Difficult to set conditions for each product	○ Has been put to practical use High freshness maintenance means of transportation
Reefer container	△ Difficult to maintain quality only by low temperature transportation	○ Suitable for transporting frozen products	△ Settings other than temperature conditions are not possible	◎ It is the mainstream of international logistics and can be handled at each port.

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Succeeded the development based on Academic Evidence !

*Reefer container maintaining the food high quality;
"fresh bank"*

R&D Results of Systems to Maintaining High Quality of Agricultural Products

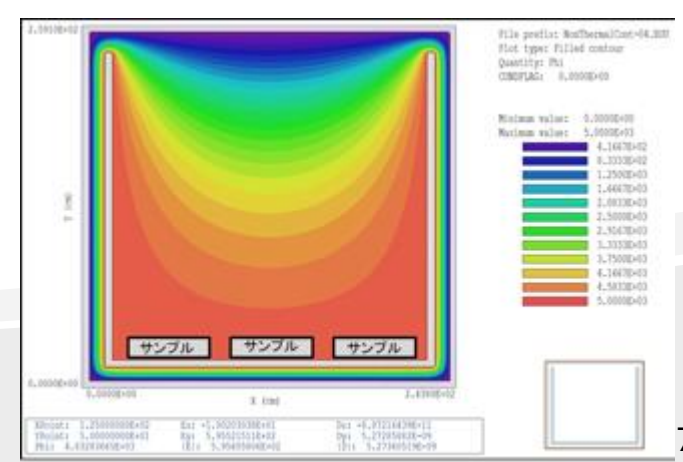
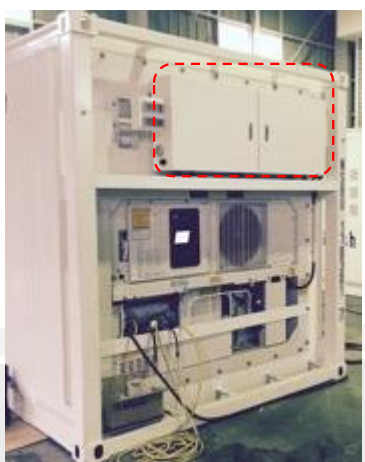
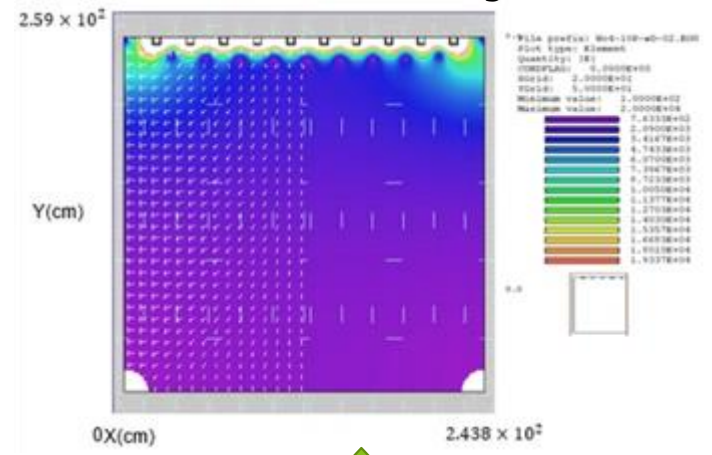
[Outside]



[Inside]



[Simulation for Electric field strength]



R&D Results of Systems to Maintaining High Quality of Agricultural Products

With Electric Field



Good quality

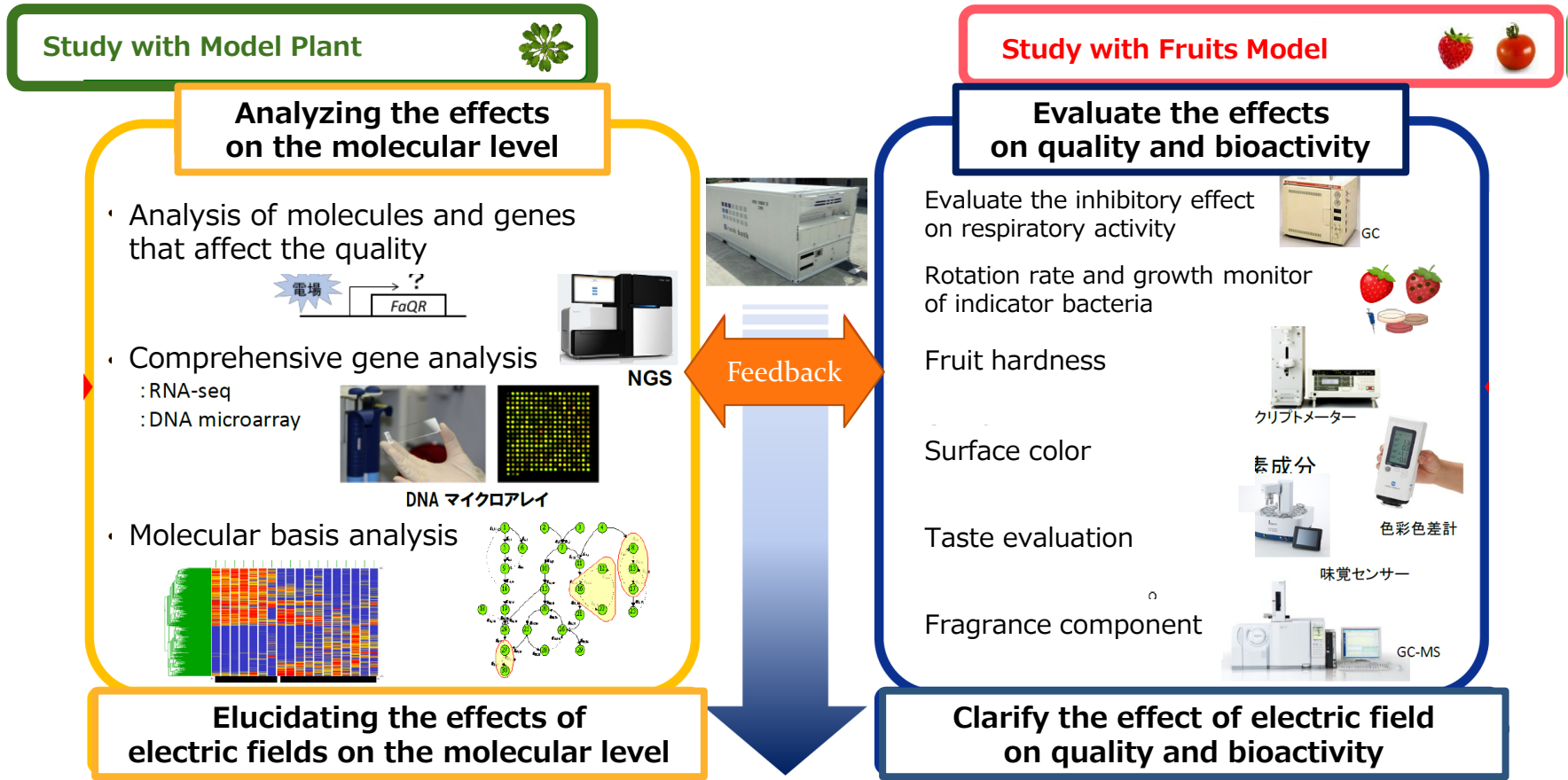
Without Electric Field



25% was mold

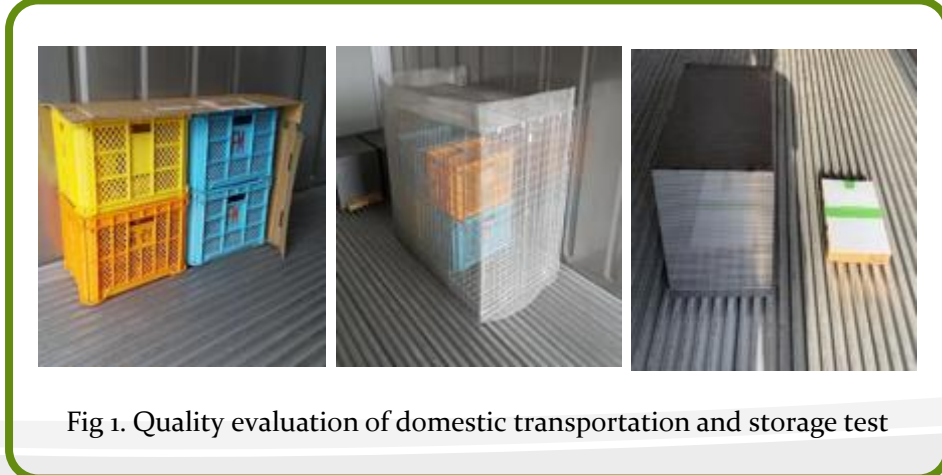
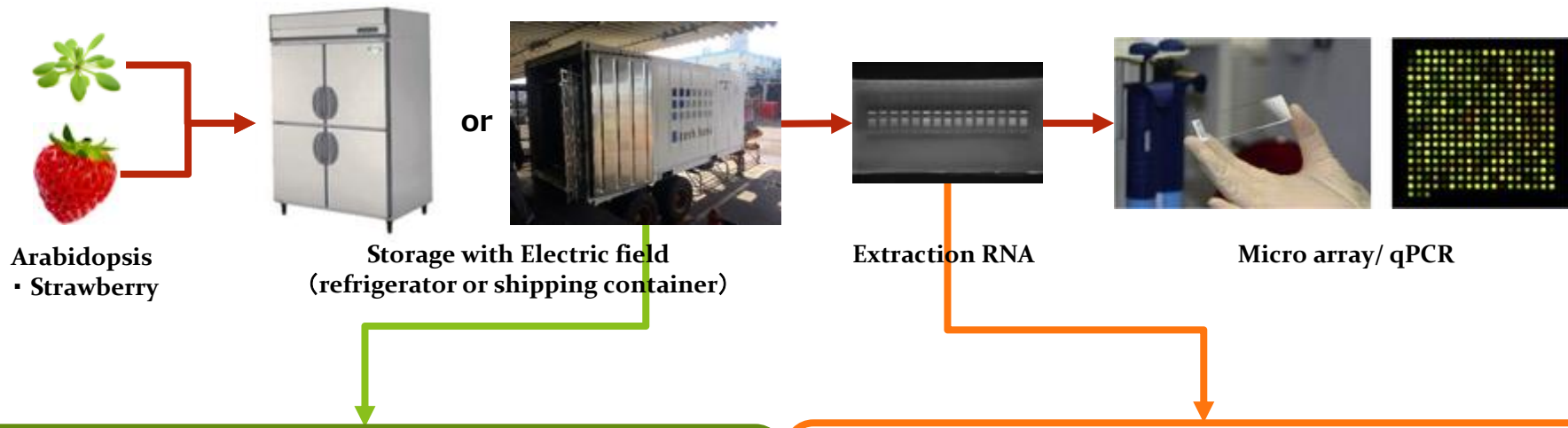
Performance evaluation in abroad transportation test:
Quality retention capacity confirmed

Experimental method: Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment



Scientifically elucidate the factors that maintain the freshness of agricultural products under the electric field at the molecular and physiological levels.

Experimental method: Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment



Results:

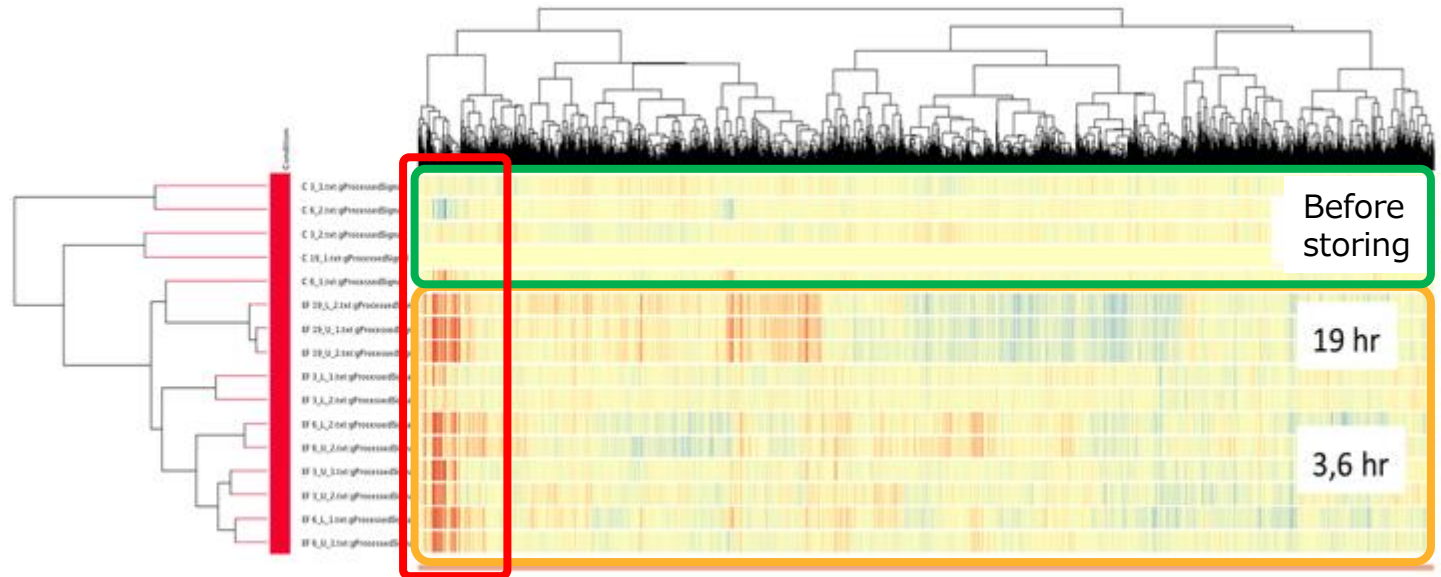
Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment



Academic Evidence

Gene expression profile analysis (clustering) of *Arabidopsis thaliana* preserved under the electric field environment

by Prof. Tashiro (**Genetic Engineering**, Kyushu University)



The electric field affects the gene expression of plants.

Results: Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment

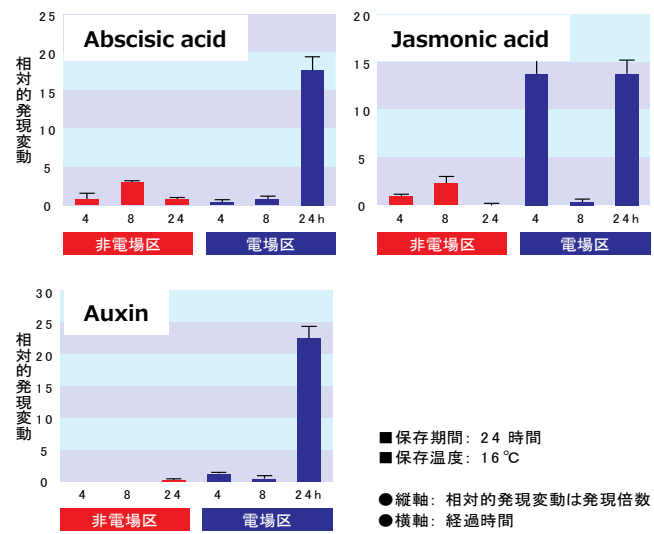
Academic Evidence

2



Expression analysis in qPCR

By Prof. Yoshida (Plant Physiology, Kagoshima University)



Suppress plant aging

- Suppressed the accelerating aging
- Promoted the suppressing aging

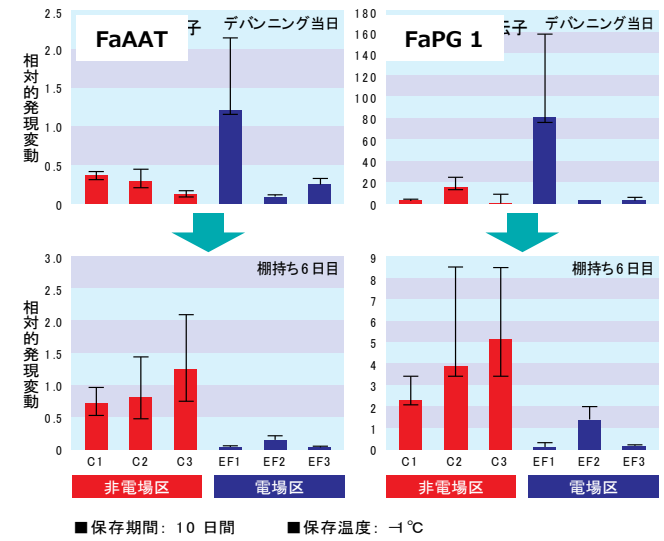
Academic Evidence

3



Gene expression of strawberry ester synthase (FaAAT) and cell wall degrading gene (FaPG 1)

By Prof. Yoshida (Plant Physiology, Kagoshima University)



the unload day after 10 days storage

The 6th day After 10 days Storage

the long-lasting quality

- Suppresses the production of aroma components and cell wall degradation

Results: Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment



4 Academic Evidence



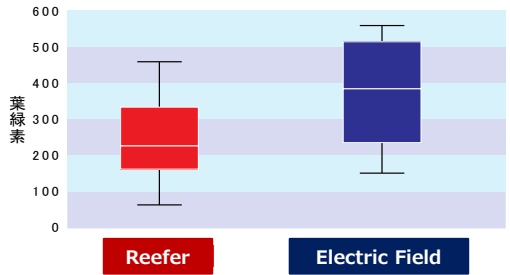
Effect of electric field on Arabidopsis leaf aging

By Prof. Yoshida (Plant Physiology, Kagoshima University)



Reefer Electric Field

Arabidopsis leaves were stored in the dark at 15 °C for 6 days.



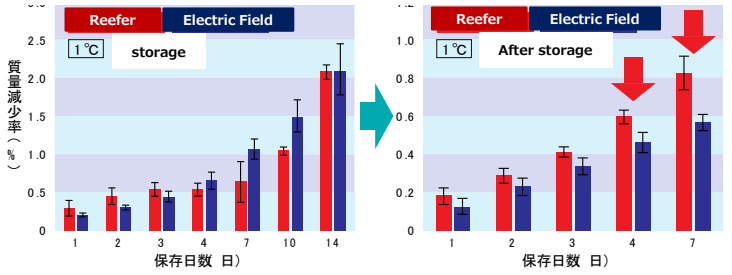
Suppress leaf yellowing

5 Academic Evidence



Decreased the ratio of cherry tomato weight loss

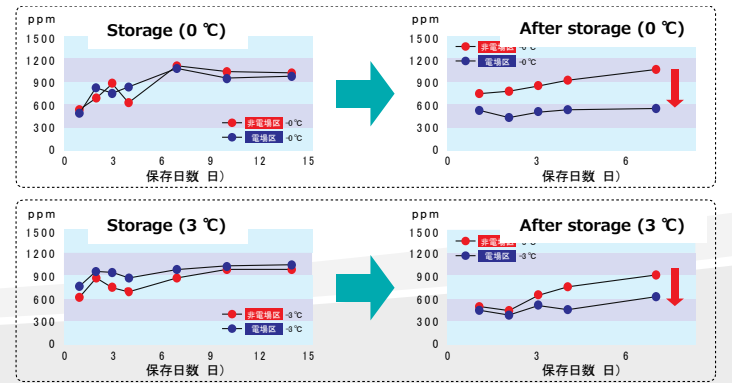
By Prof. Hamanaka (Postharvest Engineering, Kagoshima University)



The electric field may suppress transpiration

Effect of electric field on carbon dioxide emissions of cherry tomatoes

By Prof. Hamanaka (Postharvest, Kagoshima University)



The electric field may suppress respiration

Summary:

Elucidation of factors for maintaining the high quality of agricultural products under the electric field environment

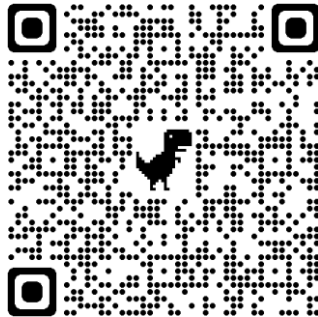
- ⇒ **Based on the industry needs, interdisciplinary academia member joins to solve the issues.**
- ⇒ **The electric field affects the plant's gene expression and physiological reactions.**
- ⇒ **The electric field might suppress the aging of plants and control long-lasting quality.**

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NITSU SHOJI CO.,LTD.
Business Department
Global Sales Division

Freshbank
Explanation
Video



Freshbank
Brochure

