

# Non-invasive Quality Evaluation of Fruits Using AC Impedance Method

Noboru  
KATAYAMA

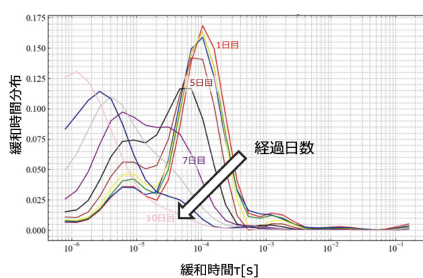
Associate Professor, Department of Electrical  
Engineering, Faculty of Science and Technology,  
Tokyo University of Science

## Purpose of Research

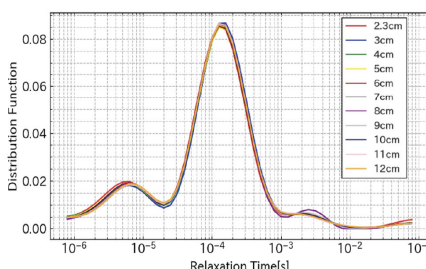
Fruit internal quality is a critical factor that determines harvest timing and market value. However, conventional methods such as near-infrared spectroscopy and gas sensors are costly, while image processing and ultrasound techniques face limitations in accurately evaluating internal conditions. In addition, measurement variability caused by fruit-to-fruit differences has reduced the reliability of quality assessment. This study aims to overcome these challenges and achieve low-cost and stable quality evaluation.

## Summary of Research

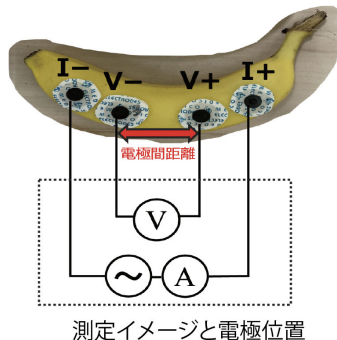
This study proposes a method that combines AC impedance spectroscopy with the distribution of relaxation times (DRT) to non-destructively and accurately evaluate internal qualities of fruits, such as ripeness and damage. The approach reduces the influence of individual differences, ensures stable measurements, and can be implemented with a very simple device.



経過日数と緩和時間分布



電極間距離と緩和時間分布



測定イメージと電極位置

## Comparison with Conventional or Competitive Technologies

- Can be constructed at lower cost compared with near-infrared spectroscopy and gas sensor methods
- Provides higher accuracy in evaluating internal fruit conditions compared with image processing and ultrasound methods

## Expected Applications

- Optimization of harvest timing through quality visualization
- Automation of inspection processes in distribution
- Freshness assessment at the retail stage

## Challenges in Implementation

- Development of highly durable electrodes
- Low-cost and reliable circuit design

## What We Expect from Companies

- Joint development of a prototype device using this method
- Demonstration tests with the prototype device

## Points

- Enables non-invasive (non-destructive) and highly accurate inspection of all samples
- Minimizes the influence of individual differences, allowing for uniform quality evaluation
- Based on an electrochemical approach, enabling automation and labor-saving in inspection processes at low cost

## Future Developments

April 2026: Prototype completed  
April 2027: Demonstration tests started

- Intellectual Property Rights: Patent Application 2025-012237
- Prototype: Available