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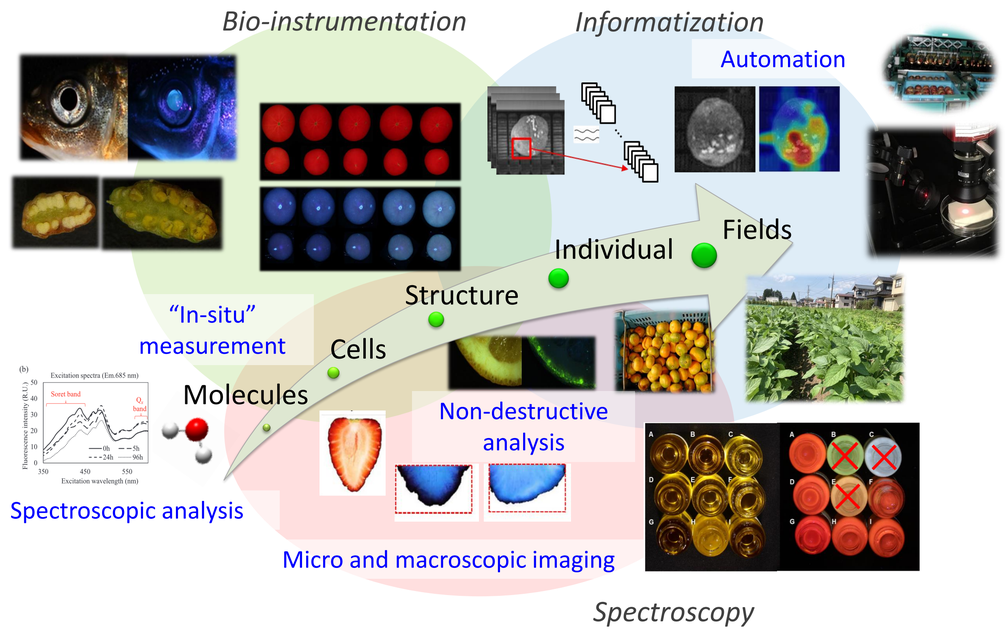
Non-destructive optical sensing of agricultural products and foods for advanced precision agriculture
超精密農業の実現に向けた農作物や食品の非破壊光センシング

【Keywords】

Non-destructive	Spectroscopy	Imaging	Crop & vegetables	Foods

■Summary

*Food production⇔environmental conservation
*“Extensive” precision agriculture is required
↓
Objective in our laboratory:
Nondestructive evaluation by optical methods
(plants, fields, crop & vegetables, foods)

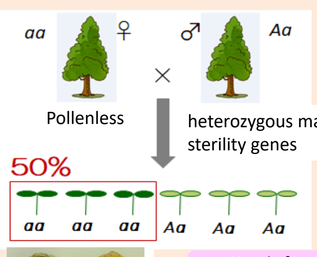


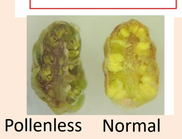
■Subject Details/Topic

【Breeding】Identification of pollenless cedar

Economic loss due to cedar pollinosis
286 billion yen /year

Pollenless cedar seedlings



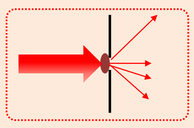


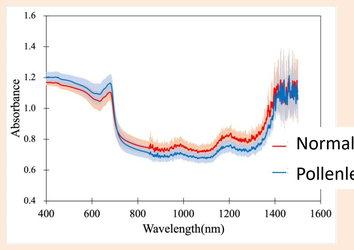
Pollenless　Normal
Internal structure

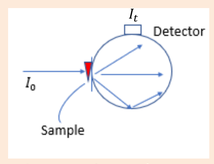
Needs for rapid and easy screening method

Identification by internal structural differences

▶**Near infrared diffuse transmittance**







Integrating sphere

Accuracy: **90.3%**

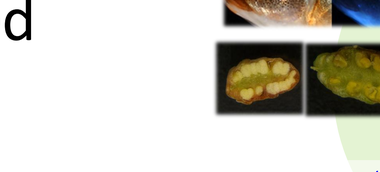
Obata et al., JCEEA2023, 2023

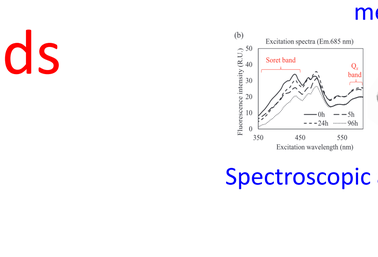
【Evaluation】Optical sensing for soybean and tofu

▶**Soybeans**

UV
Fluorescence spectroscopy

■Excitation-Emission Matrix





Protein contents estimation by EEM input

■Protein estimation

■Application idea

Fluorescence imaging

Saito et al., Food Chemistry, 365, 130403, 2021

▶**Tofu**

Visible - Near infrared

＜Microstructure＞　＜Light scattering＞

Threshold

- Porosity
- Pore density
- Pore size

Optical system

■Example: Porosity

** $p < 0.01$

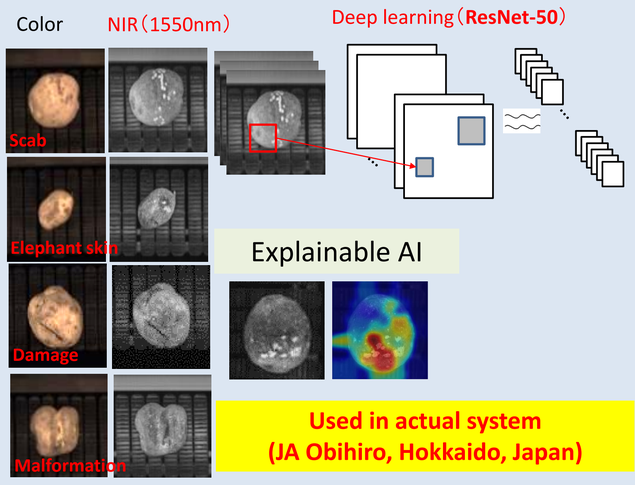
Scattering Image

Hardness estimation

Saito et al. J. JSAM, 83(2), 95-104, 2021
Saito et al., EAEF, 11, 38–42, 2018

【Sorting】Nondestructive detection

▶ **Potato classification by NIR imaging**



Explainable AI

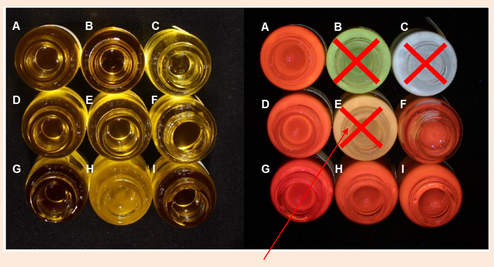
Used in actual system (JA Obihiro, Hokkaido, Japan)

Saito et al., J. JSAM, 83(3), 208-217, 2021

▶ **Olive oil adulteration detection**

Extra-virgin oil vs. virgin oil

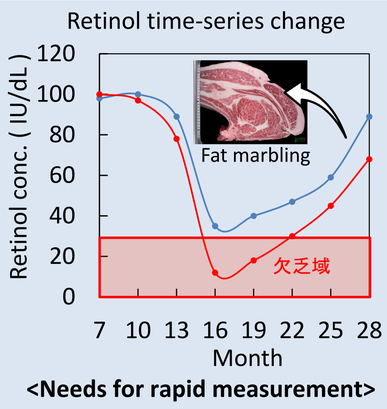
Color　**Fluorescence**



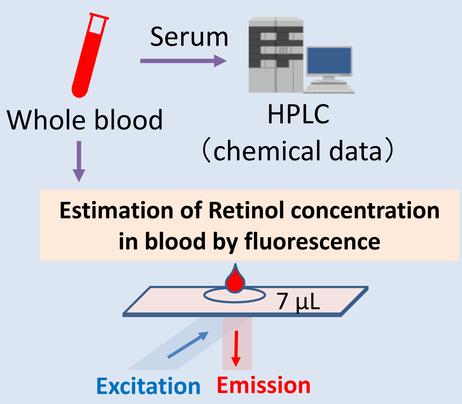
Chemical-derived fluorescence

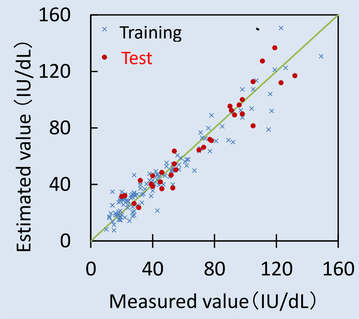
Omwange et al., Food Control, 124, 107906, 2021

【Livestocks】Vit.A estimation in whole blood



<Needs for rapid measurement>





R^2_{pred}	RMSEP	RPD
0.91	9.12	3.36

Enough for Screening

Shibasaki et al, J. JSAM, 83(6), 477–479, 2021

■We hope to collaborate with…

Nondestructive analysis, freshness or food processing monitoring, foreign matter detection

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