The Classification of the Pineapple product by the Multivariate Analysis using 3-D Fluorescence Spectra Measurement (Fluorescence Fingerprint, EEM)

INTRODUCTION

Hitachi F-7000 fluorescence spectrophotometer, with the highest throughput of 3D fluorescence spectra for the instrument class (about 3 minutes under the analytical conditions used this time), is used in a broad range of fields from cutting edge researches to the study of the application for quality control.
A sample-specific 3D fluorescence spectrum (fluorescence fingerprint) containing a large amount of numerical data can be measured without cumbersome sample preparation. The multivariate analysis is expected to be applicable to the origin identification of agricultural products as well as to the classification of grain types and grades.
This time, by using pineapple as an example for fruits products, the above technique was used to measure the 3D fluorescence spectra and the types were classified.

ACCESSORY

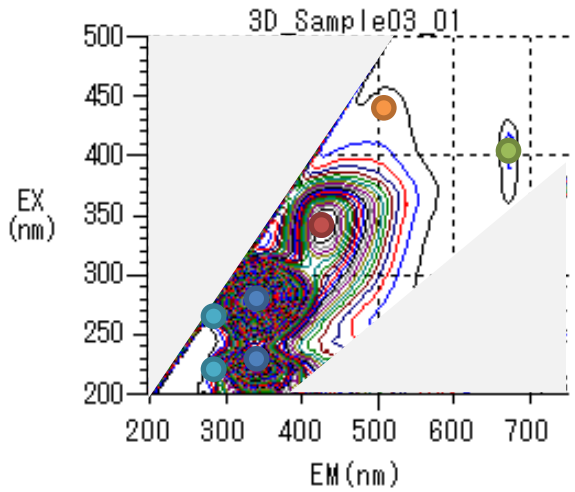
Sample :
- Juice from concentrate
- Straight juice
- Jam (Pineapple)
- Jam (Pineapple-mango)
- Canned Pineapple
- Fresh Pineapple

ACCESSORY

Solid sample holder
(P/N : 650-0161)

ANALYTICAL CONDITIONS

Instrument	: F-7000	Slit on excitation side	: 5 nm	Photomultiplier Vol.	: 400 V
Excitation wavelength range	: 200 - 500 nm	Slit on fluorescence side	: 5 nm	Full scale	: 1,000
Fluorescence wavelength range	: 200-750 nm	Response	: Automatic	Contour line interval	: 5
Scan speed	: 60,000 nm	Detector	: R928F		



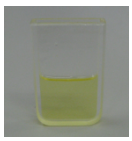


Figure 2 Cell Appearance

- L- Tryptophan
- L- Tyrosine
- Vitamin B2 (Riboflavin)
- Chlorophylls
- Ferulic acid ▪ Lignins

Figure 1 Fluorescence Fingerprint of Pineapple Juice and Prediction of Autofluorescence Substances

Figure 1 shows the fluorescence fingerprint of pineapple juice. The sample was placed in a wide cell (GL Science) and set in the solid sample holder. As a result of the 3D fluorescence spectrum measurement, the fluorescence fingerprint presumed to belong to amino acids, vitamin, and chlorophyll was obtained.

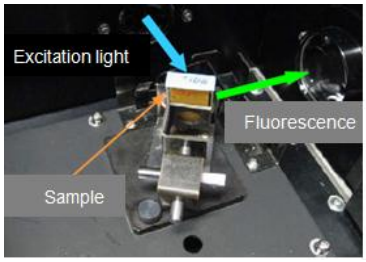
KEY WORDS
Bio/Medical Science/Food/Pharmaceutical, Food, Fruit, Pineapple, Juice, Concentrate, Fluorescence Fingerprint, Multivariate Analysis, EEM, Main Component Analysis, Approval Evaluation, Classification Analysis, 3D Fluorescence Spectrum, Starch, Food, 3D Fluorescence Spectrum, FL, F-7000

Fluorophotometer (FL)

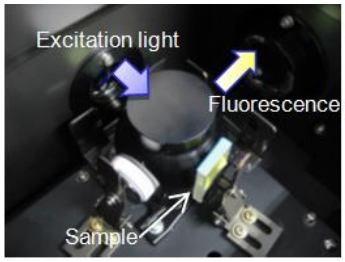
Sheet No. FL140001-01

The Classification of the Pineapple product by the Multivariate Analysis using 3-D Fluorescence Spectra Measurement (Fluorescence Fingerprint, EEM)

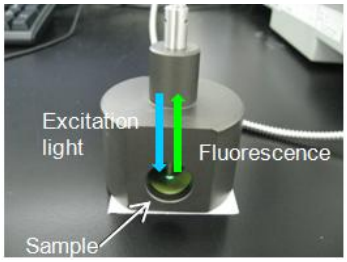
Sample Setting Methods



Surface Photometry System



Integrating Sphere System



Optical Fiber System

- For high concentration samples such as juice, the surface photometry system which measures the fluorescence on the sample surface is effective.
- When analyzing non-uniform samples such as fruit peel, the reproducibility can be improved by using the integrating sphere measurement system.
- For the direct measurement of a sample which does not fit in the sample chamber or fruit, the optical fiber measurement system is useful.

Wavelength Information of Fluorescence Fingerprint for Fruit

Table 1 An Example of Wavelength Information of Fluorescence Fingerprint for Fruit[1)]

Fluorophore	EX λ_{max} (nm)	EM λ_{max} (nm)	Group
Phenyl alanine	258	284	Amino acid
Tyrosine	276	302	
Tryptophan	280	357	
Vitamin A(Retinol)	346	480	Vitamin
Vitamin B2(Riboflavin)	270, 382, 448	518	
Vitamin B6(Pyridoxin)	328	393	
Vitamin E(α-Tocopherol)	298	326	
Chlorophyll A	428	663	Porphyrin
Hematoporphyrin	396	614	
Ferulic acid	310	418	Cell wall

Table 1 shows an example of the wavelength information for the autofluorescence detected from fruit. The fluorescence fingerprint presumed to belong to amino acids, vitamin and chlorophyll can be observed.

* The wavelength information is to be used as a reference only. The observed wavelength may be different depending on the sample condition and instruments.

1) Jakob Christensen, Lars Nørgaard, Rasmus Bro, and Søren Balling Engelsen., Multivariate Autofluorescence of Intact Food Systems, Chemical Reviews, Vol. 106, No. 6 (2006)

KEY WORDS
Bio/Medical Science/Food/Pharmaceutical, Food, Fruit, Pineapple, Juice, Concentrate, Fluorescence Fingerprint, Multivariate Analysis, EEM, Main Component Analysis, Approval Evaluation, Classification Analysis, 3D Fluorescence Spectrum, Starch, Food, 3D Fluorescence Spectrum, FL, F-7000

Fluorophotometer (FL)

Sheet No. FL140001-02

The Classification of the Pineapple product by the Multivariate Analysis using 3-D Fluorescence Spectra Measurement (Fluorescence Fingerprint, EEM)

The main component analysis was performed based on the 3D fluorescence spectrum (fluorescence fingerprint) obtained from each pineapple sample. The sample was placed in a wide cell and set in the solid sample holder. Non-uniform samples such as jam and fruit were sealed so as to ensure that the sample is in close contact with the quartz plate.

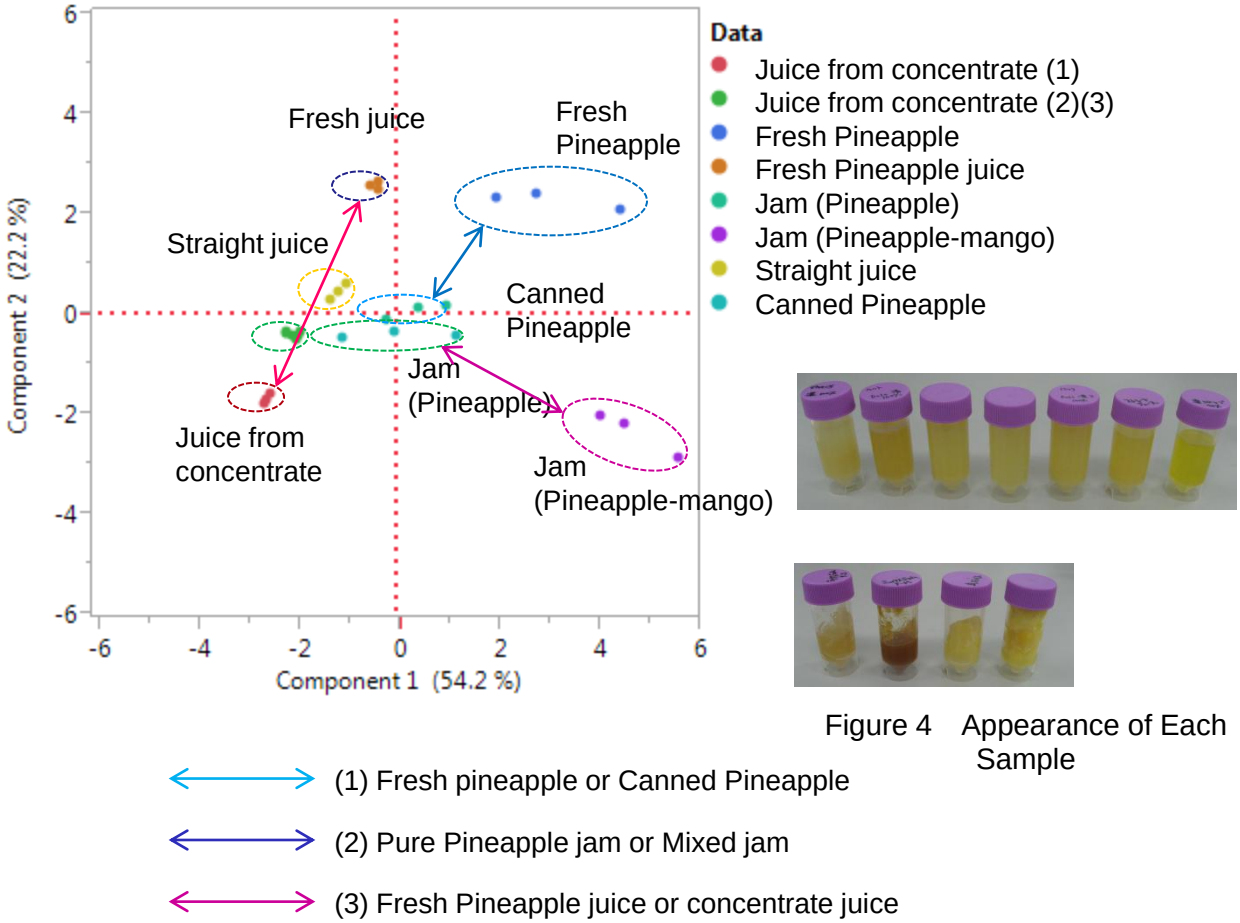


Figure 4 Appearance of Each Sample

(1) Fresh pineapple or Canned Pineapple

(2) Pure Pineapple jam or Mixed jam

(3) Fresh Pineapple juice or concentrate juice

Figure 3 Examples of Classifications Based On Main Component Analysis

[Main Component Analysis]

(1) The fresh pineapple showed positive values for the main components 1 and 2 while the canned pineapple fruits showed values near the origin.

(2) The values for the jam prepared only from pineapple were near the origin while the values for the jam mixed with mango were found to be positive for the main component 1 and negative for the main component 2.

(3) The straight pineapple juice showed the value for the main component 1 slightly lower than the origin and the value for the main component 2 was slightly positive.

The juice from concentrate showed negative values for the main components 1 and 2.

The analysis results obtained this time characteristically indicated that the higher the positive values for the main components 1 and 2, the less processed the samples are.

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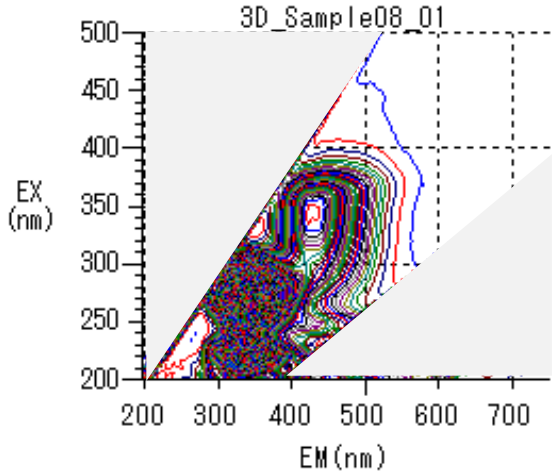
Fluorophotometer (FL)

Sheet No. FL140001-03

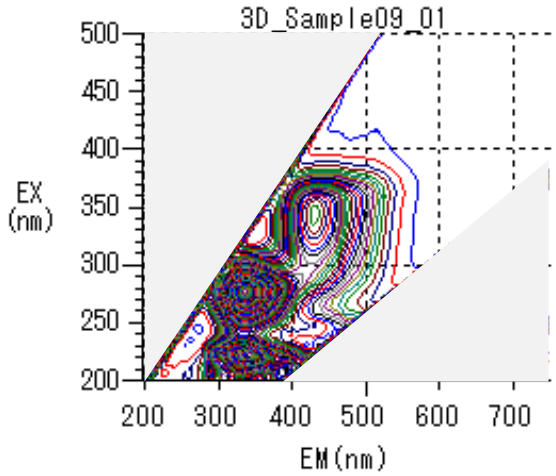
The Classification of the Pineapple product by the Multivariate Analysis using 3-D Fluorescence Spectra Measurement (Fluorescence Fingerprint, EEM)

(1) Fluorescence Fingerprint of Pineapple Fruit

Canned Pineapple

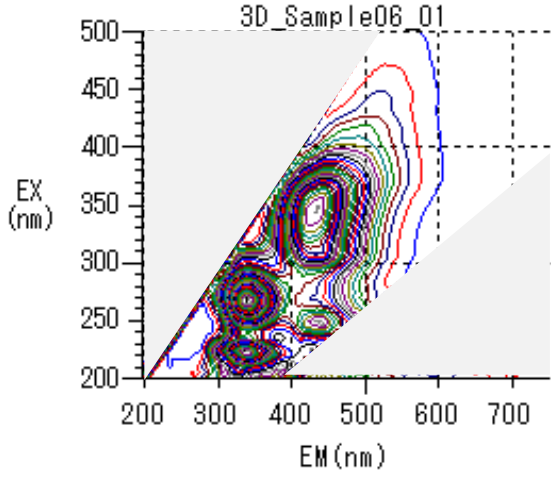


Fresh Pineapple

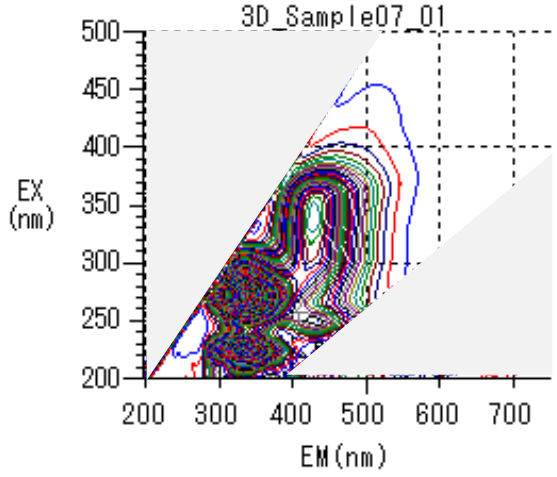


(2) Fluorescence Fingerprint of Pineapple Jam

Jam (Pineapple-mango)



Jam (Pineapple)



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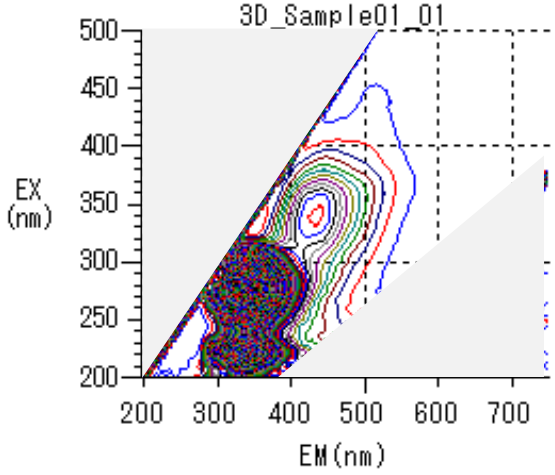
Fluorophotometer (FL)

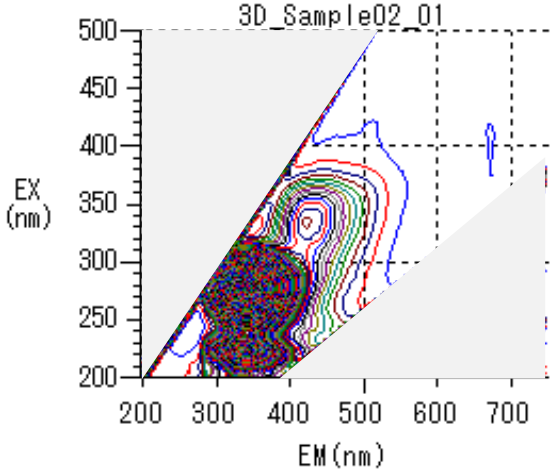
Sheet No. FL140001-04

(3) Fluorescence Fingerprint of Pineapple Juice

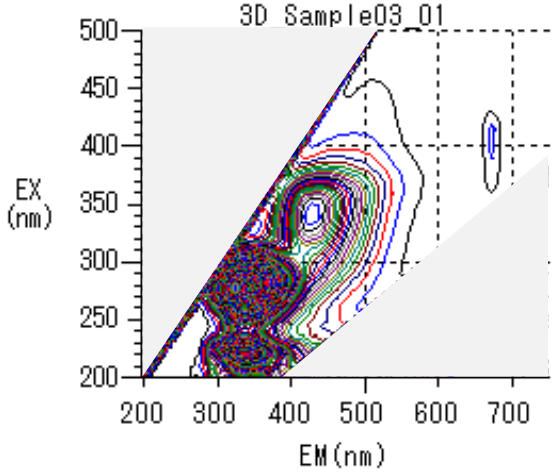
Juice from concentrate(1)



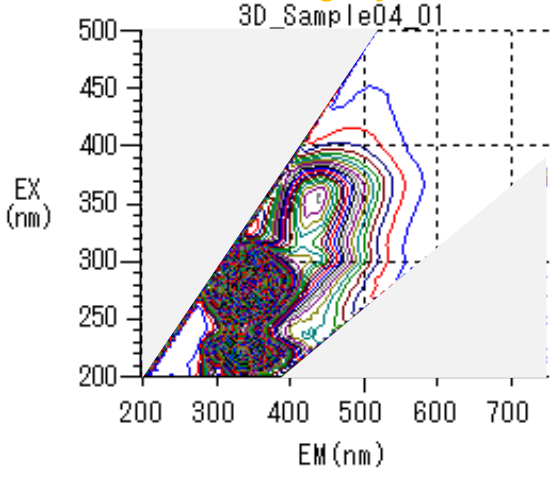
Juice from concentrate(2)



Juice from concentrate(3)



Straight juice



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Fluorophotometer (FL)

Sheet No. FL140001-05