

[Practice training course of the metabolomics]

In the Fukusaki laboratory, to acquire understanding and the technology of the metabolomics, the practice training course of the metabolomics is offered to the freshpeople of the laboratory. When graduate school is completed, the globally advanced metabolomics technology can be acquired by understanding the policy of this course and digesting the program. By making both this training course completion and degree thesis research completion a graduate school requirement, Fukusaki laboratory aims at the training of the work-ready researcher skilled by the world highest level of the metabolomics research area.

(The reason for which the training course is necessary)

The metabolomics that is the composite region of bioscience, organic chemistry, the analytical chemistry, and the informatics just still made a dent on both sides of technical development and the operating method development. We are developing a novel technology of an analytical system of the metabolomics and a novel operation method.

In the research of the metabolomics, a central aim is to obtain profitable knowledge by mining the observational data obtained from various analytical instruments. Acquisition of data with high quality that accuracy and reproducibility are assured and operation of steady data analysis system are necessary for an advanced metabolomics research. To achieve the above-mentioned, the technology improvement, standardization, and sharing in the laboratory become indispensable.

The students at the master course take a pivotal role on training course. And we execute an original training course intended for freshpeople of the laboratory. In particular, students conduct the lecture and the practice of each analytical instrument, and it is a minimal purpose to make the student who receives guidance come can do processes from the experiment to maintenance alone. And, the student who receives the training course turns to the instructor in the next fiscal year. By learning in B4, teaching in M1 and supervising in M2, knowledge is verified and the ability of the lead and the presentation that becomes important in the society is developed through the experience of OJT (On the Job Training).

English version training course 2009 for international students (Held in Oct.)

It was held for 3 international students who entered in Oct. in 2009.

Contents

I. Lecture

- A. Introduction
- B. Mass Spectrometry (MS)
- C. Gas Chromatography (GC)
- D. Liquid Chromatography (LC)
- E. Fourier transform near-infrared spectroscopy (FT-NIR)
- F. Capillary electrophoresis (CE)
- G. Supercritical fluid chromatography (SFC)
- H. Data analysis

II. Practical training

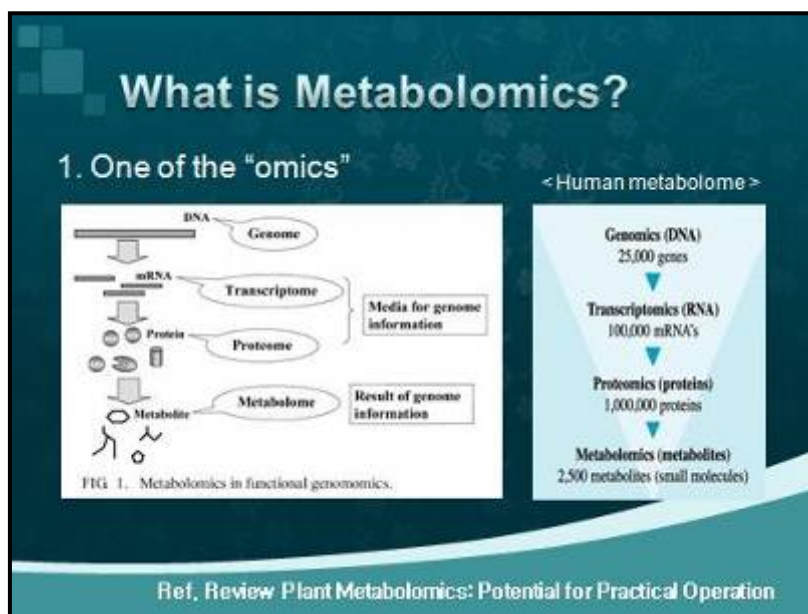
- A. GC/TOF-MS practice
- B. UPLC/TOF-MS practice
- C. FT-NIR practice

III. Feedback

I. Lecture

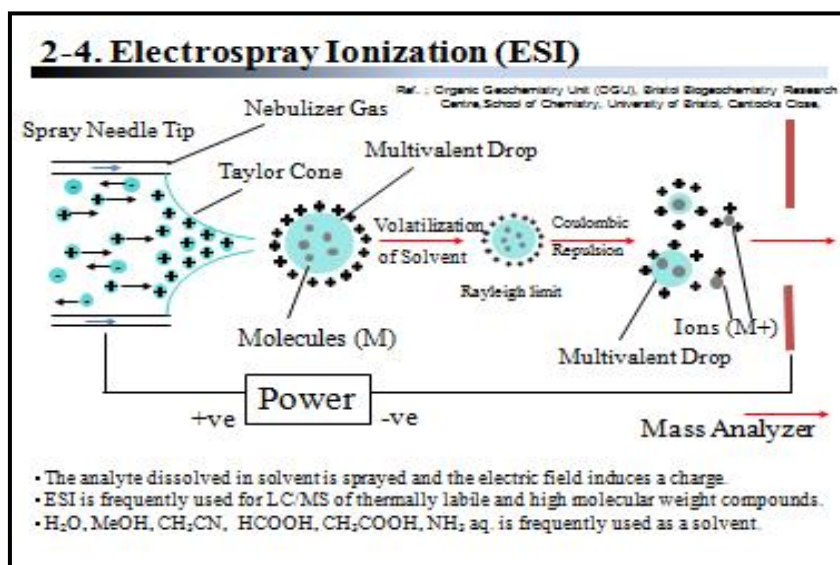
A. Introduction

- What is metabolomics?
- Grouping of metabolomics
- The basis of analytical instrument



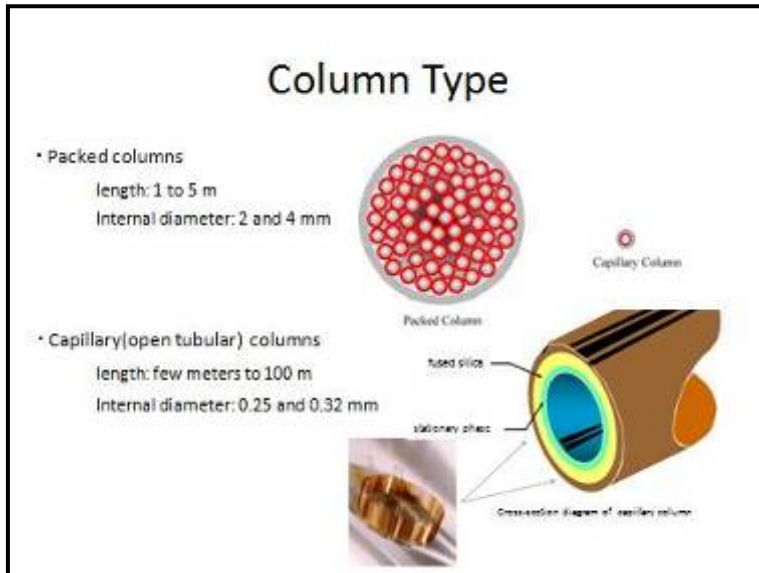
B. Mass Spectrometry (MS)

- Ionization techniques
- Matrix effect (ionization suppression, ionization enhancement)
- Mass analyzer (Quadrupole, Time-of-Flight, Ion Trap)
- Characteristic of mass analyzers
- Fragment
- Quantitative procedure



C. Gas Chromatography (GC)

- what is GC/MS
- the basis of GC
- the advantages and disadvantages of GC/MS
- the applications of research by using GC/MS
- maintenance of GC/MS



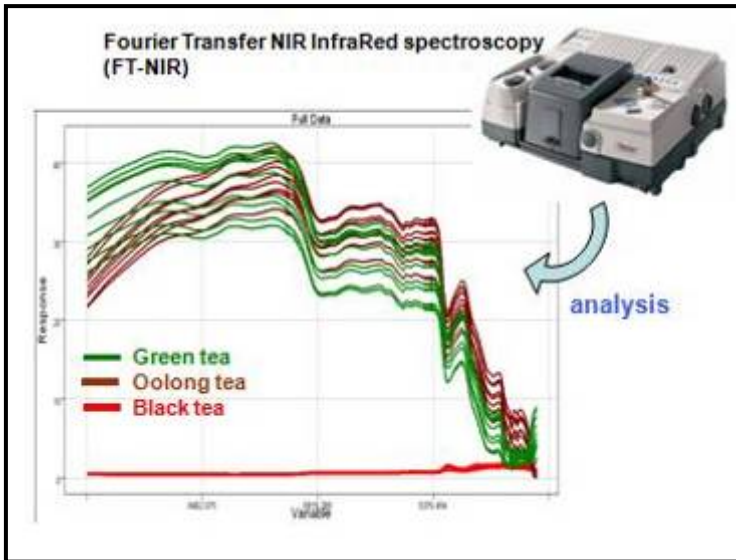
D. Liquid Chromatography (LC)

- LC system
- Separation mode of LC
- LC/MS overview
- Detectors
- Important matters of LC/MS
- Chromatographic performance



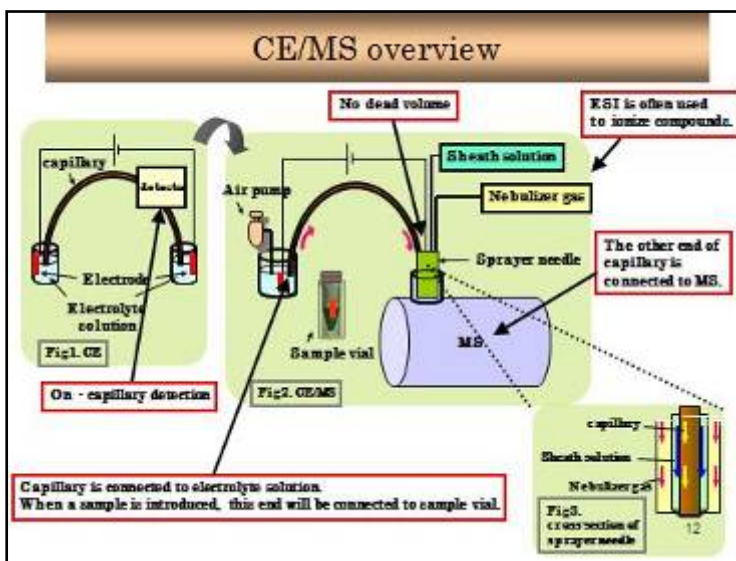
E. Fourier transform near-infrared spectroscopy (FT-NIR)

- what is light?
- what is FT-NIR?
- the basis of FT-NIR
- the advantages and disadvantages of FT-NIR
- the applications of research by using FT-NIR
- maintenance of FT-NIR



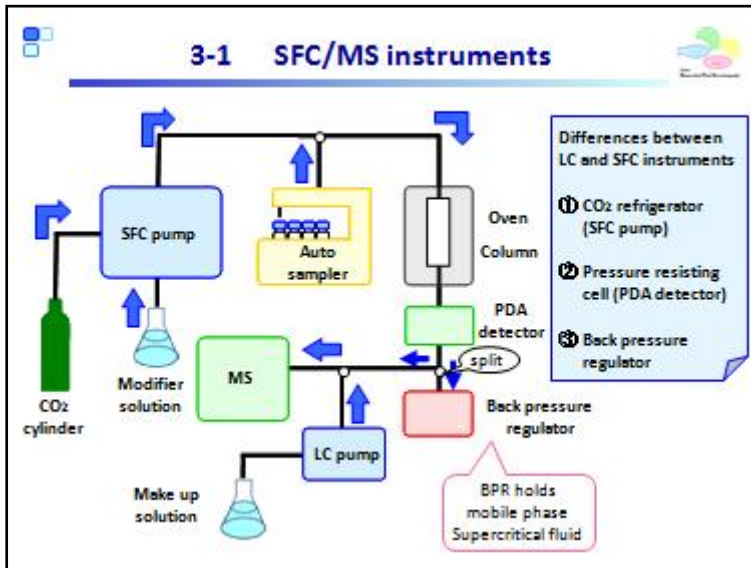
F. Capillary electrophoresis (CE)

- What's CE?
- What's EOF (electro osmotic flow) ?
- CE/MS overview
- What is sheath solution for ?
- Characteristic of CE analysis
- Analytical methods



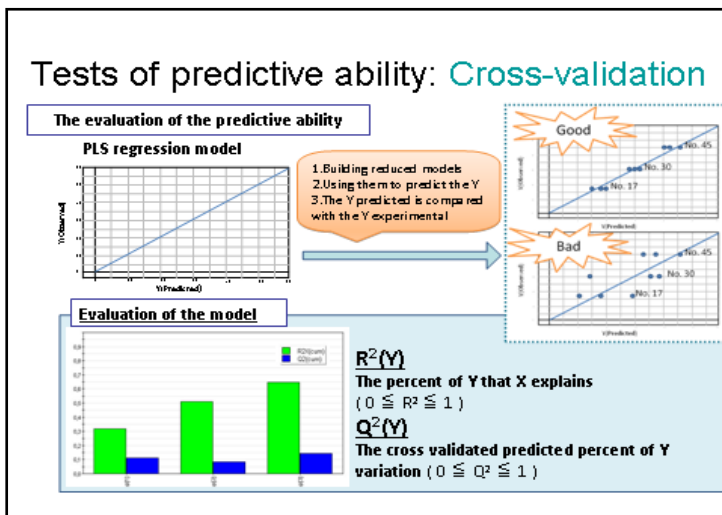
G. Supercritical fluid chromatography (SFC)

- About supercritical fluid
- Applications of supercritical fluid
- Supercritical fluid chromatography (SFC)
- Characteristics of SFC
- Comparison with GC and LC
- SFC/MS applications
- Supercritical fluid extraction (SFE)



H. Data analysis

- Data preprocessing
- Multivariate analysis
- Principal Component Analysis (PCA)
- Partial Least Squares (PLS)
- Data transformation
- Data processing
- Multivariate analysis



II. Practical training

The objective of this practical training is to learn the procedures used in metabolomics research. The contents are divided into 3 sections, which are sample preparation, instrumental analysis and data analysis using 3 instruments. The program is planned to continue for 3 weeks, one instrument will be used per week. Here I introduce the past contents concretely. For example, yeasts or tea leaves are used as samples. First they are prepared for next instrumental analysis. Second they are analyzed by using GC/TOF-MS, UPLC/TOF-MS and FT-NIR. Finally, using the data from instrument analysis, multivariate analyses such as PCA (Principal Component Analysis) and PLS (Projection of Latent Structures) were conducted. In addition, the minimal techniques for maintenance were practiced for each instrument. Because you operate by yourself, you can deepen the knowledge which was acquired from fundamental lectures.

Table 1 Contents of practical training

Instrument	Biological sample	Multivariate analysis
GC/TOF-MS	Tea	PCA
UPLC/TOF-MS	Yeast	PLS
FT-NIR	Tea	PCA

A. GC/TOF-MS

- Extraction of metabolites in tea leaves
- Derivatization of metabolites
- GC/TOF-MS analysis
- Alignment of chromatograms
- Normalization
- PCA (checking the score plot and loading plot)
- Discussion
- Maintenance (column exchange, filament exchange)

GC/TOF-MS



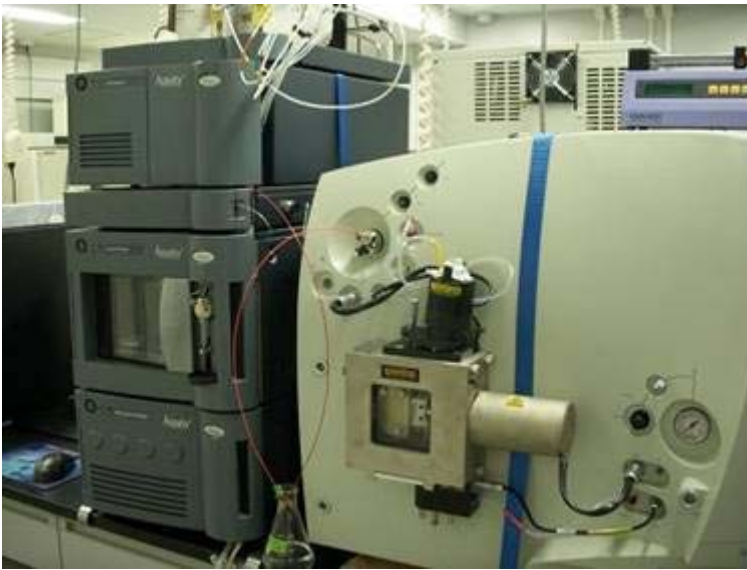
Scene of experiment



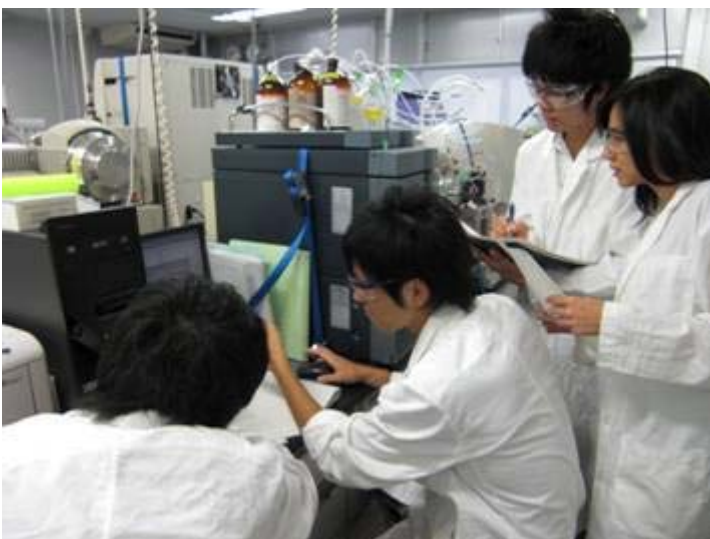
B. UPLC/TOF-MS

- Extraction of metabolites in yeasts
- UPLC/TOF-MS analysis
- File conversion for data analysis
- Alignment of chromatograms
- Normalization
- PLS (making prediction model)
- Discussion
- Maintenance (setup of instrument, column exchange, column equilibration, cone cleaning)

UPLC/TOF-MS



Scene of experiment



C. FT-NIR

- Extraction of metabolites in tea leaves
- Comparison of analytical method
- FT-NIR analysis
- PCA
- Discussion
- Maintenance (explanation about attentions in turning off instrument, probe exchange)

FT-NIR



Scene of experiment



III. Feedback

Japanese students

Students (B4)

- I think it is easy to understand because everyone taught carefully about basic contents of analytical chemistry.
- Kindly documentations and animation of Power points helps us to understand

Lecturers (M1)

- We could have chances to brush up through giving lectures of Training courses.
- Supervisor or other laboratory members let us know about the mistakes in lecture, we could get correct knowledge.
- Students should be aggressive to ask questions and clarify what is incomprehensible!!

Supervisor (M2)

- Lecturers should make more efforts to prepare the lecture of training course!!

International students

(In 2009)

- I think it is good because we do not know the equipments in the lab at first. So we need to understand something in the lab in advance. The training course is very appropriate for us.
- Everyone treat me well and repeat the content until I can understand.

(In 2008)

- In 2008, I came to Fukusaki lab. and it was my first time to study about metabolomics. I learned about many components from other members by training course. For example, GC/MS, LC/MS, NIR-spectrometry, and multivariate analysis. It was very helpful for my study and I'm very appreciated to all the members of lab.