

Metabolomics 2014

Tenth annual international conference of the metabolomics society

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Introduction

Metabolomics 2014, the 10th Annual International Conference of the Metabolomics Society, was held from June 23rd to 26th in Tsuruoka, Japan. This conference was Official Joint Conference of the Metabolomics Society and Plant Metabolomics Platform. The conference had more than 550 participants from 39 countries. Conference programs, presented as workshops, presentations, and posters included a variety of application fields for metabolomics, such as drugs and medicines. Metabolomics is a growing field in “omics” studies, and intense discussions marked each session. The sessions were divided into eleven broad topics: (1) *Drug & medicine*, (2) *Flux, microbiology, & parasitology*, (3) *Cancer*, (4) *Cardiovascular disease, (CVD), diabetes, & neuroscience*, (5) *Data analysis*, (6) *Networks*, (7) *Nutrition, environment & model organism*, (8) *New technology* (9) *Plant physiology*, (10) *Omics integration*, and (11) *Crops*. Each session started with keynote speakers known as leading scientists in their respective field of metabolomics. Luncheon seminars, hosted by metabolomics instrument vendors, were a great opportunity to have great meals and learn about metabolomics instruments.

Workshops

On the first day, before the main conference, a workshop on the topic of “Metabolomics data standards, data capture, and exchange” was held. The creation of metabolomics data reporting standards was the primary discussion during this workshop. There are growing numbers of

articles related to metabolomics, but data interpretation is still not standardized. Different researchers interpret metabolomics data in different ways. In other words, interpreting data sets to publish in journals is not well regulated. There is a Metabolomics Standards Initiative (MSI) group, consisting of many leading scientists in fields of metabolomics, that has the purpose to set reporting standards. This effort will benefit global scientific community by standardizing reporting method for the journal publication. Since, metabolomics is in the early phase of growth, new software and standards must be continuously developed. Additionally, researchers presented and emphasized the importance of creating new data gen-

eration software consisting of a database for analyzing raw data from platforms.

Drug & Medicine (Pharmacometabolomics)

This session was directly related to the main scope of the Journal of Translational and Clinical Pharmacology. The main focus of the session was on “How to use metabolomics in biomarker discovery and how drugs affect patient metabolite level”. Metabolomics can be applied in variety of fields of drug and medicine, its effect extends from new drug development to predicting the consequences of drugs administered to patients with certain diseases. Since clinical metabolomics studies mostly compare diseased samples



Figure 1. A live performance of Taiko (Japanese drums) by a local group at the conference banquet

with normal samples, it can be considered as one of the fields of science which is directly related to human health conditions.

The field of metabolomics involving both drugs and medicine is called “pharmacometabolomics”; the major aim of this field is to quantify the endogenous metabolites affected by a certain drug and predict the post-drug response. Pharmacometabolomics can broadly cover many different fields from pharmacology to clinical studies. Even though, pharmacometabolomics is on the right track for use in clinical diagnosis, there are not many reported cases of using a novel biomarker in clinical studies. Thus, validation steps should be reinforced to use novel biomarkers in clinical diagnosis. Scientific confirmation of novel biomarkers can enhance diagnosis and prescriptions for individuals with certain diseases.

Metabolomics in drugs and medicines involves animal toxicity tests. Unites States Food and Drug Administration (FDA) “Guidance for Industry: Safety Testing of Drug Metabolites 2008” requires that animal study must be conducted when formed metabolites from the drug are greater than 10% of parent

drug systemic exposure at the steady state. When drugs are metabolized in the human body, they could possibly be metabolized into metabolites with a high level of toxicity. By using metabolomics techniques, the metabolites produced from drugs can be detected, and we can understand how those metabolites affect the human body.

Flux, Microbiology & Parasitology

Metabolic flux analysis is a method of measuring metabolomics activities of organisms *in vivo*. This session covered topics from biofuels to microbial findings. Microorganisms play critical role in human life since they are involved in food fermentation and gut microbiota, which are greatly correlated with human health. The novel tool of metabolomics can highlight what kinds of microorganisms will beneficially coexist with human beings and what kinds of secondary metabolites produced by microorganisms might have positive effects on human health. Furthermore, the quality of probiotics can be improved by highlighting the microbial metabolic pathway

Cancer, and CVD, Diabetes & Neuroscience

Cancer is considered as one of the unsolved problems in science. Genomics studies have been developed in the hope of solving this problem; however, there are still barriers to overcome. Cancer is known to be inherited from generation to generation but there are also incidents in which it arises from environmental factors such as foods. The goal of this field would nonetheless be to find novel biomarkers which would detect cancers. The metabolomics approach to cancer (oncometabolomics) might find novel biomarkers for detecting cancers. Although metabolomics focuses more on environmental factors than inherited factors, combining metabolomics with genomics brings us one-step closer to a solution.

Cardiovascular disease and diabetes are intensely studied in metabolomics because they are the two most common diseases among many patients. Metabolites analyzed from biological fluids might indicate either the cause of the disease or new way to cure the disease by applying biomarkers in clinical studies.

Data Analysis, Networks, New Technology, and Omics Integration

In metabolomics study, more than one platform must be used to provide broader coverage of metabolites. However, the platforms required can be expensive and reduce the cost-effectiveness. Thus, it is best to use least number of platforms which still provides the best result. This session discussed the best combinations for use in metabolomics platforms among different studies. Also, as previously stated, there were intensive discussions on setting standards. Sample size determination is one of the standards that must be set, because authors of articles often state the small sample size as a limitation of the study; to set this standard, a statistic approach might determine the appropriate sample size.

On the other hand, since one platform cannot explain and detect all of the metabolites in samples, the development of

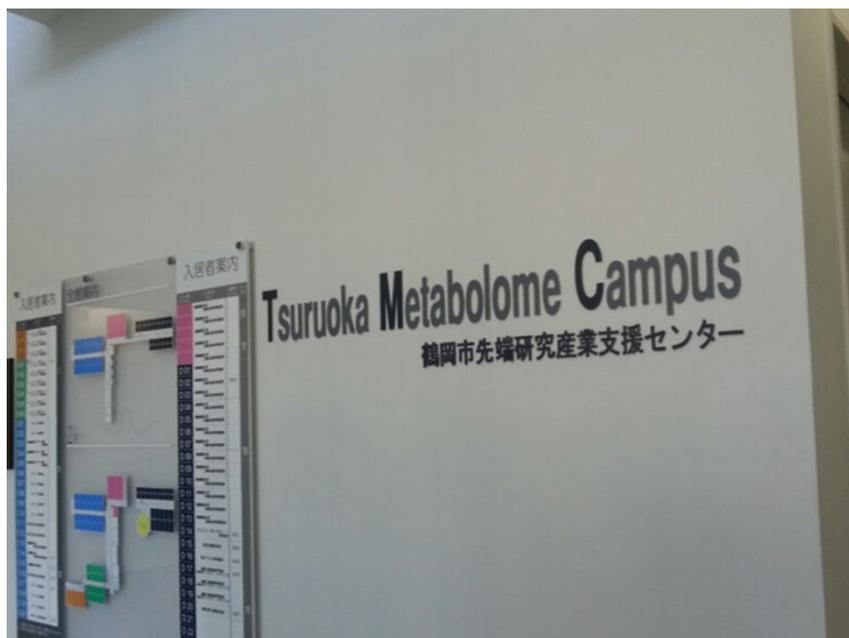


Figure 2. Laboratory tour at the Institute for Advanced Biosciences (IAB), Keio University

novel methods of metabolomics analysis is important. Thus, using of multiplatform metabolomics analyses was one of the emerging topics of this session.

In this area of metabolomics, omics integration was also discussed from unique brain lipidome to metabolomics database perspectives. Omics studies including genomics, transcriptomics, proteomics, lipidomics, metabolomics, *etc.* must be combined in the future to provide a big picture; metabolomics alone is not enough. Thus, integration of metabolomics with other kinds of omics studies is one of the keys to get closer to the final goal.

Nutrition, Environment & Model Organism, Plant Physiology, and Crops

The main discussion in plant metabolomics was about how metabolites detected in certain organisms can be used as nutrients for human health. “Exposome” is a word that describes the totality of human environmental exposures. Since, environmental factors are critical in metabolite levels, studying the “exposome” provides insight and opportunities to find environmental factors which negatively affect human health.

A part of the plant metabolomics is dealt with analysis of different plants either genetically or phenotypically. The diversity among species of plant families can be

explained with genetics but also through the study of metabolomics. Species can have different phenotypes with different secondary metabolites.

“How to make better flavored crops” is a continuing major interest in crop metabolomics. Application of metabolomics to crops (agriculture) is the field of metabolomics with the longest history. What people eat can directly affect human health. Thus, observing metabolites produced from crops can aid the development of better-flavored dishes with more nutrition.

Conclusions

The main topic of the 10th Annual International Conference of the Metabolomics Society was about “setting the standards in metabolomics.” An initiated group, Metabolomics Standards Initiative (MSI), was formed in 2005 to regulate the reporting standards in metabolomics, which will benefit global scientific community by standardizing reporting method for the journal publication. Among the many different fields of metabolomics, pharmacometabolomics is one of the growing fields. Pharmacometabolomics has the potential to transform our understanding of drug action mechanisms and the molecular basis for variation in drug responses. Thus, pharmacometabolomics, together with pharmacogenomics, can play an important role in predicting both

drug efficacy and drug adverse effects in an individual. Metabolomics has direct clinical applications; thus, intensive studies are currently in progress. By optimizing the application of metabolomics in clinical studies, the research capacity of metabolomics will be increased, and lead us to new understandings regarding the complex interactions of drug and human biology; furthermore, the ability to anticipate drug safety and effectiveness for patients will be increased. At the end of the conference, the 11th Official Annual Meeting of the International Metabolomics Society (2015 in San Francisco) was announced; this upcoming conference will focus on “Metabolism and its role in biology and medicine”.

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