

Preface to Special Issue “Food Safety and Food Health”

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1. Introduction

Since around the end of 2019, when the world was mobilized to fight against the SARS-CoV-2 virus, investment in infection control measures, vaccine development, and other areas of the life sciences have increased, and new innovations and the digital transformation (DX) of society have progressed at previously unimagined rates.

Vaccination programs are hoped to bring a quick end to the COVID-19 pandemic, however returning to the previous status quo seems unrealistic after this crisis abates. In a new state of society called “new normal,” we need to deal with changes with the sustainable development goals (SDGs), which were adopted by the United Nations in September 2015, in mind.

In 2000, amid a declining birthrate and aging population, Japan’s Ministry of Health, Labour and Welfare established a multi-term national health promotion program named “Health Japan 21.” The goals of the second term of this plan (2013 to 2022) are to extend healthy life expectancy and reduce health disparities across Japan. Food is considered to play increasingly important roles in people’s health. In April 2015, Japan introduced a new labeling system for functional foods with a lower barrier to inclusion than the previous labeling system for foods with specific health uses. Perishable foods are included under this system, which establishes food functionality as an important aspect of food quality in addition to safety.

Aside from regulations under Japan’s Food Sanitation Act, analytical technology is playing increasingly important roles in ensuring food safety. For example, every newly emerged threats to food safety, mislabeled foods and microplastics being two recent examples, typically require development of new analytical methods to address them.

This special issue of Shimadzu Review covers collaboration with the National Agriculture and Food Research Organization (NARO), Japan aimed at extending healthy life expectancy as well as new analytical methods and applications related to food safety and health through food.

2. Collaboration with NARO

As Japanese society and the wider world face a range of challenges, such as increasing lifestyle diseases, aging populations, and since the spread of the COVID-19 pandemic, the market for healthy foods looks particularly strong. In regions throughout Japan, there is an increasingly powerful movement in agricultural sites to improve market competitiveness by developing agricultural products and foods that help maintain or improve health.

Given these circumstances and market trends, since 2016, Shimadzu Corporation has partnered and collaborated with NARO on initiatives related to food innovation and making positive impacts on society through food. Shimadzu deeply invested in these initiatives and hopes that this collaboration will accelerate the development of agricultural products and foods with functional components and encourage initiatives that support regional development built on agriculture and related sectors. As a manufacturer of analytical instruments, Shimadzu believes it has a significant role to play in these endeavors.

This article describes the events that led to Shimadzu’s collaboration with NARO and the details of ongoing research activities.

3. Lipids as Functional Components

Lipids include a wide range of functional food components, and while there is an immense amount of research into the functional components of food, determining the function of every single functional lipid component poses a significant challenge. The recent emergence of ultra-fast multiple reaction monitoring (MRM) for triple-quadrupole mass spectrometers has facilitated the development of analytical methods that can analyze hundreds of lipid molecules in a biological sample, and these methods are used to search for disease-related biomarkers and evaluate functional properties. This article presents the development of

an ultra-fast MRM-based analysis method for lipids in human serum, describes using this method to analyze food (mackerel), and discusses differences between the fatty acid balance of human serum and mackerel.

4. Applying Multivariate Analysis in Food Quality Evaluation

Food quality is evaluated by a wide range of methods depending on the food type and objectives of the evaluation. Once gas chromatography-mass spectrometry (GC/MS) or liquid chromatography-mass spectrometry (LC/MS) has been used to perform a total analysis of food components, it is now commonplace to characterize those food components by multivariate analysis in an analytical approach called food metabolomics.

This article presents examples of multivariate analysis being used to identify varied brands of beer and subtle differences in quality between different production lots and production sites in the same brand of beer.

5. Approaches to Flavor

A large volume of research and development is focused on revealing scientifically why certain foods are considered more desirable, and gas chromatography (GC) and gas chromatography-mass spectrometry (GC/MS) are commonly used to study aroma and flavor in this field. GC is typically used to analyze and assess specific target components while GC/MS is used for the comprehensive analysis and assessment of many components. This article focuses on sulfur compounds that can affect food quality even at trace levels and presents the following two methods of analyzing foods by GC and GC/MS.

- (1) An analysis of total volatile sulfur in beer by gas chromatography-sulfur chemiluminescence detection (GC-SCD)
- (2) A new technique for food odor analysis using GC-MS and GC-SCD

6. Objective Evaluation of Food Texture

Among the elderly and people with oral impediments who are less able to chew and swallow food, ease of food ingestion has a direct effect on safety and is a characteris-

tic that requires evaluation. "Ease-of-eating" is often evaluated by sensory-based techniques, but these evaluations are difficult to reproduce due to inter-person differences in perception and day-to-day changes in physical condition.

This article describes the EZ-SX texture analyzer that provides quantitative measurements of food texture to complement sensory evaluation techniques.

7. Shimadzu Analytical Technology that Supports Food Safety

Shimadzu's analytical instruments can detect residual agrochemicals, veterinary drugs, mold toxins, and allergenic substances in food with high levels of sensitivity and aid in ensuring food is safe for consumption. The pollution of rivers and oceans with microplastics is increasing throughout the world, and there are rising concerns about the impact of microplastics on the environment and people through drinking water and food.

Studies into microplastic pollution conducted in countries throughout the world typically use Fourier transform infrared spectroscopy (FTIR) to identify types of microplastic. This article covers the sequence of steps involved in microplastics analysis, presents example analyses of microplastics recovered from rivers and marine organisms, and describes how to use the Plastic Analyzer, a plastics analysis system specially designed for the analysis of degraded plastics.

8. Conclusions

Technological developments related to foods, including plant factories, genetic modification, meal alternatives, insect-based foods, and microplastics, cover a wide range of topics. These developments not only include analytical methods that ensure the safety of fresh and processed foods, the identification of functional components that aid human health, and the pursuit of flavor, but also the search for solutions to societal issues such as food shortages and environmental problems. Through the research and development of analytical instruments and peripheral systems, and through the deployment of these instruments and systems in society, Shimadzu aims to create new markets and leverage increased growth while enhancing its positive impact on society. We hope this special issue on food safety and health through food is pertinent to the specialist fields of its readers and generates fresh perspectives and understanding.