CHAPTER 5
ADVANCEMENT IN FOOD QUALITY ANALYSIS

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5.1 INTRODUCTION

Food is one of the basic necessities of all living organisms and undoubtedly forms the foundation of humankind. Food has always been the epicenter of human civilisation and is often considered as a part of the human culture. With the increasing world population and the depleting natural resources including fertile land and clean water, the issue of food security and safety is becoming even more significant. The Food and Agriculture Organisation of the United Nations (FAO) predicted that 52% of world population may live in countries with national averages of over 3000 kcal/person/day in 2050, up from 1.9 billion or 28% at present. On the other hand, the population of people who live with less than 2500 kcal/day is predicted to be decreasing from 35% currently to 2.6% in year 2050 (Alexandratos & Bruinsma, 2012).

In addition, our lifestyle has also changed over the years. Food preparation used to be a household affair but nowadays we mostly buy our food from outside. Thus, how the food we eat is sourced, processed, prepared and finally end up on our plates becomes of great concern.

The increasing demand of safe and high-quality food has necessitated new approaches for food quality assessment that is quick,

precise and reliable. In addition, food fraud caused by deliberate adulteration, mislabelling or incorporation of lower quality ingredients has become a serious issue, both for the industry and regulatory authorities. In recent years, various new methods and analytical equipment with high accuracy and fast results have been developed and emerged as new tools for evaluation of food quality and safety. One example is the fourier-transform infrared (FTIR) spectroscopy, an analytical tool which can measure spectral information obtained from various food samples. FTIR is a relatively easy and quick method with minimal or no sample preparation required. It also involves no hazardous solvents, making it a green and environmentally friendly approach. Combined with chemometrics, which is the mathematical and statistical analysis of chemical data, FTIR can be a powerful tool for food quality assessment.

In this chapter, we will present the overview of food quality analysis and describe briefly the conventional and advanced methods in food analysis. Next, we explain some of the recent studies in food quality analysis, with a special emphasis on FTIR as a simple, green and cost-efficient analytical method. We describe the general workflow and strategies for implementing FTIR-based food quality assessment. The procedures and working principles will be described, including the protocol for performing multivariate data analysis, followed by several examples of past research that has successfully applied the method. The challenges in dealing with highly complex and big datasets will be discussed. Furthermore, current issues and future prospective will also be explored. This chapter aims to provide a comprehensive guide to fourier transform infrared spectroscopy (FTIR)-based chemometrics technique that may be implemented not only by research labs, but also by food manufacturers/operators as well as regulatory authorities.

5.2 OVERVIEW OF FOOD QUALITY ANALYSIS

Food analysis is essentially aimed at ensuring the food meets standard requirements of safety and health, as well as the sensory and nutritional

claims. It is an interdisciplinary field which combines food science, analytical chemistry, mathematics and microbiology, among others. Food analysis is routinely performed by the food industry and the government or regulatory agencies.

5.2.1 Types of Food Quality Analysis

There are many types of food analysis, depending on the type of food. Largely, it can be divided into four categories: (1) Physicochemical analysis which includes the determination of physical and chemical properties such as colour, moisture content, water activity, pH and nutritional compositions; (2) Sensory analysis which determines the attributes such as taste, aroma, texture and overall perception; (3) Microbiological analysis to test the presence or viability of foodborne pathogenic bacteria and other microorganisms such as yeast and mold; and (4) Molecular analysis which may include genome sequencing and DNA or protein analysis, typically to determine the authenticity, traceability or *halal* status of the food. While physicochemical, microbiological and molecular properties are often evaluated using analytical equipment or through standard analytical methods, sensory tests are normally performed by panels of evaluators, either trained/expert or untrained panels. The results of these tests are not only used for compliance with food safety regulations, but also used for product development and improvement.

5.2.2 Purpose of Food Quality Analysis

Food production involves several stages in the food supply chain (Figure 5.1). Depending on the type of food product, some may be directly obtained from the farmer, while others include rigorous processing along the supply chain. Regardless, each food must be guaranteed safe to be consumed.