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Research Article

The Application and Development of Measurement in Guaranteeing the Food Safety in China

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Abstract: Measurement plays an important role in the process of food safety testing. The study of the application and development of measurement in guaranteeing food safety is of great theoretical and guiding significance. This study expounds the concept of measurement and the recent application of measurement in guaranteeing the food safety in the domestic and international areas and analyzes the function of measurement in the detection of food safety. Furthermore, some useful countermeasures and suggestions are put forward to improve the measurement system of food in China. The aim of study is to provide a reference for establishing a perfect mechanism for the implementation of food measuring work.

Keywords: Food safety, guarantee, measurement

INTRODUCTION

Food is the basic of the people, safety is the precondition of the food. With the improvement of living standards, food is no longer just the basic elements of human survival. People pay more attention to food safety and have higher requirements for the quality of diet. However, it is not sure that food is absolutely safe (Borchers *et al*., 2010). Food is a kind of material with complex composition. As the rapid development of the food industry, globalization of the food supply was increased, food technology was innovated continuously, new raw materials was generated and added to the food. This changes the variety of food, meanwhile brings greater risks (He, 2003).

Food safety has become a global problem. In recent years, Food safety events of home and abroad occurred frequently. These events not only caused the huge economic losses, but also seriously shaken consumers' confidence for food safety (Jonge *et al*., 2004). Food safety need guarantee through the detection of food safety. However, the current food safety detection cannot meet the demand of the market. Measurement is carried out throughout the process of food safety test, it is the foundation of food safety test. We must give full play to the role of measurement in the detection of food safety to obtain accurate, reliable and comparable detection data. The study of the application and development of measurement in food safety protection is of great theoretical and practical significance, which provides a reference for establishing a perfect mechanism for the implementation of food measuring work.

CONCEPTION OF METROLOGY

Metrology is an activity which is to realize the unification of units of measurement and ensures accurate and reliable of values. It is based on recognized standards of metrology, according to the laws and regulations of metrology and the legal metrological verification system make dissemination of value of quantity to ensure the accuracy of the measurement (Yuan, 2008).

The content of metrology includes the following several aspects: Units of measurement and unit system; measuring instruments, which include implementation or replicate metrological benchmarks of standards of measurement, standards and measurement instruments; dissemination and traceability of value of quantity, which include verification, calibration and test, inspection and testing; measurement of physical constants, materials and material properties; uncertainty, data processing and theory and methods of measurement; measurement management, which include measurement assurance and measurement supervision. Metrology has the characteristics of accuracy, consistency, traceability and legal (NBQTS, 2001). Essence of metrology is consistency, the core of

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metrology is accuracy, the purpose of metrology is accurate and reliable of measure results (Chen, 2007; Song, 2010).

FUNCTION OF MEASUREMENT IN GUARANTEEING

Measurement plays an important role in the process of food security (Derek and Olivier, 2013). To determine whether food is safe or not, measurements should be on the premise that measuring methods are standard and correct and some people who was trained measuring by the laboratory accreditation of various instruments for scientific detection. Measurement penetrates the whole process of food safety testing, including sample preparation, sampling, detection method, test results and so on (Pu, 2009). Any problems in the link of the measurement may result in food safety (Yang and Lu, 2007).

Essentially speaking, food safety testing is metrology (Liu and Pu, 2008). Measurement is the basis of standard and provides technical support for establishment, perfection and implementation of standard (Li, 2010). Measurement also is the basis of measuring instruments, detection methods and quality assurance system. Only effective measure is to meet the needs. Effective measurements must be reliable and comparable, otherwise is invalid measurements. It will be waste of resource and even lead to wrong decisions, have incalculable consequences (Franz, 2011). Most of food safety monitoring, with standard substance in measuring instruments to obtain the data, is comparative measurement so as to obtain the detection result. Food safety detection has many characteristics, such as many detection characteristics, rapid detection technology and wide distribution range of detection mechanism (Xu *et al*., 2009). The characteristics of accuracy, consistency, traceability and legal of measurement determine that measurement is a powerful tool in the detection of food safety (Huang, 2012; Ruan *et al*., 2009).

Application of measurement in guaranteeing the food safety: The application of measurement in guaranteeing the food safety is still at the stage of development. The reliability of the analysis results has been greatly improved when measurement is being applied to the food safety testing. These applications include high quality reference standard, repeatedly verified sampling method, test method and calibration method, national standard materials of food category, the establishment and evaluation of relationship between uncertainty accuracy of measurement and traceability, skilled test process and so on (Iyengar, 2007).

Application of food safety standards: In recent years, more and more countries are beginning to realize the importance of measurement in food safety monitoring and establish a number of local and international cooperative organizations for food safety.

Application of international food safety standards: Asia Pacific Economic and Trade Organization food safety cooperation forum was established in 2007, its purpose is to strengthen food safety standards and reduce unnecessary international trade barriers. International Bureau of measurement has also joined the WHO, IFCC, National Institute of Metrology and its designated agencies and other international organizations, in order to research and develop the standard system of peptide and protein measurement technology (Siu-kay *et al*., 2012). The UK established food standards agency in 2000, which was aimed at ensuring food safety in the UK. Recently, with the help of the British Food Standards Agency, Scotland has decided to set up a new regulatory agency for food safety, food standards, food labels, to strengthen food safety standards, nutrition and labeling policies, meat inspection policy and thus solve the problem of Scotland's bad eating habits, food borne diseases and so on.

Application of food safety standards in China: The overall number of national and industry standards of food hygiene and quality is huge in China. There are cross duplication and disconnect between the standards. Individual important criteria and indicator are missing. That seriously cannot meet the needs of food safety supervision and industry development. In June 2012, the Ministry of health and other eight departments issued the "food safety national standards plan". One of the main tasks of the food safety standards in China is to speed up the formulation and revision of the basic standards of food safety during the "Twelfth Five Year" period (the Ministry of Health, http://baike.baidu.com/view/8801956.htm). In October 19, 2012, the Ministry of Health issued "Food standard cleaning work program", launched the schedule of the formulation and revision of food safety national standards. At present, China's food safety risk assessment center has launched a number of 5000 clean-up work of food standards. Before the end of 2013,China would complete the setting and revision work of the food safety national standards and establish the only mandatory food safety national standards system in 2015 (MOH, 2013; Lu, 2013). In January 10, 2014, the national health and Family Planning Commission announced 4 new food safety standards on its official website. Food safety general standard is constituted for formula food for special medical purposes, prepackaged food, pathogenic bacteria in food and so on (NHFPC, 2014). Subsequently, national health and Family Planning Commission issued 75 food safety national standards, which would be curried out on June 1, 2014, in order to

fill the lack of our food spices and other quality standards and regulate the food additives labeling.

Application of food standard substance: The biggest challenge in the face of food safety testing is how to obtain the test data with compatibility, which is also in other laboratories, can be verified. The effective method is to detect the measurement standard or standard reference material of international certification.

Application of international food standard substance: As of August 2013, the international standard material database (COMAR) collected 10200 kinds of Certified Reference Material (CRMs), in which 397 kinds of food products were certified reference materials (He *et al*., 2014). At present, there are several international institutions obtaining some achievement for the research of standard substance. These institutions include International Organization for Standardization (editing the standard material information library), National Institute of Standards and Technology (NIST), EC Standard Material Bureau, European Union standard material and test society, British Government Chemical analysis laboratory (LGC) and so on. The Quality Advisory Committee established by the International Committee on Weights and Measures (CIWM) aims to carry out a wide range of international comparisons of measurement data in the field of food and medicine. Nowadays, many countries are also improving their national standards for reference, to fight for international level synchronization. The National Institute of Standards and Technology (NIST) has developed a number of Standard Reference Material (SRMs) for the measurement of different ingredients in different foods (Phillips *et al*., 2013). Vitamin C is an essential element of human body, which plays an important role in the human body. Since Vitamin C cannot be synthesized by human body, it must be obtained through the intake. But excessive consumption will also cause a certain amount of damage, food labels must be clearly indicated with the content of Vitamin C. Two standard substances provided by NIST cannot be detected in vitamin C in vegetables and fruits. In order to fill the lack, recently NIST used liquid phase chromatography to determine the concentration of vitamin C in the standard reference substance of three kinds of food (Thomas *et al*., 2013). Japan's National Institute of measurement also released a reference material used for detection and analysis of pesticide residues in apple in 2012, this aspect of the reference material is very little (Otake *et al*., 2013).

Application of food standard substances in China: Our country is laggard in the beginning of studying the standard material, but the development speed is very fast. Under the leadership of the China Institute of measurement science, there are currently more than 30 units participated in the development of food standards. The developed food standards include 52 primary standard materials, 202 secondary reference materials and more than 400 kinds of certified reference materials related to food analysis (Cai, 2014; Wei *et al*., 2013). With the increase of toxic and harmful substances, food additives and so on, the demand for food standard substance is also increasing. China's standard material research institutions pay close attention to the development of the standard substance, so that the amount of food standard substance in our country can catch up with the level of developed countries.

Application of food safety testing method: With the increase of food composition complexity, new packaging materials, toxic and harmful substances, there must be new and fast detection method ensuring food safety.

Application and development status of international food safety testing methods: Food testing methods are time-consuming and high cost and the developed countries in Europe and the United States are working to develop a convenient and efficient method for testing. The European Union researched a project entitled "improving consumer confidence in food safety" and had made an achievement in the detection of antibiotics in honey. A method for rapid detection of 4 kinds of antibiotics residues had already been studied and was currently being applied (S&T, 2013). Nano materials, as a kind of new packaging materials, has brought many benefits to food, such as improving the food's resistance to storage and preventing food from being contaminated by microorganism. But there is a problem arousing people`s attention, because of mobility and potential of breaking through biological barriers, Nano materials may develop into large particles, which can enter the organs of the sensitive population and cause harm to the body (Linsinger *et al*., 2013). Nano material is very difficult to determine in size and quantity. At present, detection and description of nano materials in complex foods are not available. Some of the international projects are addressing this issue, such as the EU's "Nanolyse" project and the United States Department of agriculture related projects, etc (S&T, 2013).

Application and development status of food safety testing methods in China: The food safety testing organizations, such as the Scientific Institute of measurement and research, are working to improve the national standard physical library. At the same time, they have studied the detection method of many kinds of food, food packaging materials, food additives and other toxic and harmful substances. All of these greatly

improve the ability of food safety testing laboratory to detect and trace in our country and provide protection for international certification for food safety inspection results. The detection method of pesticide residues has been greatly developed in recent years and the technology of pre-treatment and the detection of the instrument have been further developed. Pesticide residue detection method was developed from single residue detection to multi residue detection. Tandem mass spectrometric detection technology, comprehensive two-dimensional gas chromatography mass spectrometry, time Of Flight Mass Spectrometry detection technology (TOF-MS) etc. were applied to the development of high-throughput, high sensitivity, high selectivity, high degree of separation of pesticide multi residue analysis method (Zhu *et al*., 2013). The detection of irradiated food also developed some effective detection methods, such as pyroelectric analysis, chemical analysis, Electron Spin Resonance spectroscopy (ESR), etc. ESR is able to quickly detect whether the food is irradiated (Xu *et al*., 2004; Wang *et al*., 2013). Biological technology is more and more widely being applied to the domestic food safety detection, including FTA-PCR (Flinders technology associates-PCR), LAMP (loop mediated isothermal amplification), nucleic acid probe, substrate molecular imprinting technique, biochip technique, immunochromatography, biosensor. These techniques not only reduce the detection cost, but also greatly improve the efficiency of detection (Liu *et al*., 2013).

COUNTERMEASURES AND SUGGESTION

The measurement of food has been widely used since the implementation of this study. The application of measurement in guaranteeing the food safety contributes greatly to the reliability of the food safety testing results and thus to ensure the food safety. But there still exists some deficiencies in our country’s food measuring work which need to be improved.

Speed up the formulation of food standards: The applicability of China's food safety legislation to the food safety international standards is not enough. Some developed countries take food safety international standards as their own safety standards. Only when the national standard is higher than the international standard, they use their own standards. But in China's food safety legislation, the international standard is only used as a reference and no specific application. Besides, the standard of our country is still in a very confused state. The coverage of the standard is not wide enough and the standard cannot follow the development needs of modern industry and agriculture. In addition, the participation is not enough for China's enterprises in the formulation of food safety standards and international organizations’ activities. Food safety more is the responsibility of the enterprise, so we should increase the participation of enterprises (Tu and Zhang, 2013; Zhao and Zheng, 2013).

Aiming at the present condition of our country, some measures should be taken in terms of food standards. We should follow up the clean-up work of standard as soon as possible, strengthen the formulation of food safety standards, expand the coverage of the food standards and apply the international standards for food safety to our country's food safety law and standard. Thus try our best to meet with the international standards as soon as possible. Only in this way, can we minimize the risk of food safety, but also to maximize the protection of consumer safety. And in the process of setting standard, we should increase enterprise's involvement. When the standard is drawn up, we should strengthen the publicity in enterprise in order to raising the awareness of food safety responsibility of enterprises.

Strengthen the development of standard materials of food: The existing standard materials of our country cannot meet the needs of measurement. The standard material of food in our country has already obtained certain growth in quantity, but there still be a big gap compared with the developed country. The standard material in food additives has insufficient coverage and many types of matrix don`t have corresponding national standard materials. However, the price of standard materials provided by international is expensive and labs of testing are required to bear the high cost in importing them. These factors bring a lot of inconvenience to the daily inspection and monitoring of quality safety (Chaudhry and Castle, 2011).

Institutions related to the standard materials in China are expected to develop more standard materials which the quality is qualified and the price is affordable, especially some of standard materials related to detection of transgenic food, mycotoxins, natural toxin, pesticide residues, food additives and so on, which have a big gap with foreign countries, are in urgent need.

Establish and improve food safety testing method: Accurate and reliable food safety detection method play a key role in the assessment of risk and food safety. The current situation of food safety is grim. Increasing food additives, residual pesticide and mycotoxins, without exception, endanger the lives and safety of consumers. In view of the current severe food safety situation, developing a kind of detection technology which possesses lots of detection types, high detection speed, high sensitivity and wide range of detection is the development trend of the future. Detection method towards residual pesticide and food additives in China has been greatly improved, but further innovation and complement are still needed.

CONCLUSION

Measurement is a kind of activity aimed to realizing the unification of units of measurement, ensuring accurate and reliable measurement value which determines its importance in the detection of food safety. Measurement is both the basis of food safety detection and the most effective tool to ensure the food safety. As the basic guarantee of food safety, measurement becomes the most basic work of the food safety supervision. Continue to strengthen the application of measurement in the field of food safety is one of the most effective way to solve China's food quality and safety problems in food security work. In the future, we should exert the function of measurement and improve the deficiencies existed in measurement of food. Thus let the measurement better service to food safety and to the society.

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