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Food Authenticity and Safety in China: What about the Western World?

Abstract: In last years there are numerous food safety incidents in China, and the consequence is that the consumers in this country are losing confidence in domestic food suppliers, and that food safety is becoming a controversial issue in this country. In order to improve this situation, Chinese government now prioritized safety regulation for food products and additives and specified the limits of potentially dangerous ingredients. Chinese scientist recognized the importance of omics in both food science and technology early on, and they will play a key role in realization of this process. In the second part, the issues of food safety and authenticity in Western World were discussed, and recent accidents were depicted. The continuing need for food safety and increasing demand for protection against adulteration of food products is also introducing a growing request for introduction of foodomics methods in food technology and quality control.

Keywords: Food authenticity, food safety, China, Western World, Foodomics

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SQ Foods-2012 in Shenzhen, China

I have been invited by the Organizing Committee to give a lecture at the "BIT's 1st Annual World Congress of SQ Foods-2012" (Theme: Science, Safety, Quality and Sustainability), and I was pleased to accept. The topic is "Application of Proteomics in Food Technology and Biotechnology" [1]. I was also looking forward to networking with Chinese colleagues working in this field.

High quality lectures dealing with pressing topics and problems within the field of food technology and biotechnology were presented, however, the role of 'omics' was unfortunately somewhat underrepresented [2,3]. Chinese scientist recognized the important role of omics in both food science and technology early on [4-6], but none of the contributors from China working in this field participated at this meeting. Moreover, of 80 lecturers at the meeting, only one was from the host country [7]. Consequently, I was disappointed in the lack of opportunity to contact fellow colleagues. As mentioned earlier, it is obvious that Chinese scientists are aware that omics play a very important role in all of the fields that were presented at the meeting, namely food science, safety, quality and sustainability. The organizers were also well informed and in the invitation mentioned our recent review papers discussing the application of these technologies [8,9]. Is there no interest in application of omics for food safety in this big, rapidly developing country? In contrast to China, recent publications in this field and lectures presented at this meeting show rapidly growing interest for application of these techniques in Brazil, another rapidly developing economic power [3,8,10].

I happened upon an unusually honest report in one international newspaper published by the Chinese Officials during my stay in the country discussing the problem of food safety in China [11]. According to the author, "it seems there is at least one media story about food safety incidents every month in China". After the first melamine milk scandal, in which six babes were killed and 300,000 were left sick after consuming infant formula contaminated by melamine, there were additional, almost unbelievable reports about nine additional food scandals in this country. These scandals included restaurants serving food with cooking oil recycled from kitchen waste, decomposed animal fat and organs from slaughterhouses, pork contaminated with the weight loss drug clenbuterol, and toxic bean-sprouts contaminated with heavy metals like cadmium [11,12]. The consequence is that Chinese consumers are losing confidence in domestic food suppliers, and that food safety is becoming a controversial issue in this big country. A lot of consumers, especially those belonging to the fast growing, well-educated middle class are now instead patronizing international

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chains that guarantee food traceability, quality, and safety especially regarding the origin of the food. Consequently, some domestic food suppliers are have started to invest in modern food production and supply chains. However, there is still a lot to do in order to win back consumers' confidence. The failure of government regulation and supervision of food production are also recognized, and food safety regulations must be significantly upgraded. According to the existing plan, the government should prioritize safety regulations for food products and additives and specify limits of potentially dangerous ingredients. Moreover, standards should be set for testing of additives, microbial and chemical contaminants, as well as pesticides and drug residues [12]. In summary, there are a lot opportunities for the use of "omics" technologies to achieve these goals [8, 9, 13]. Ultimately, the comments of China Daily are still optimistic: "Domestic food brands still have plenty of opportunities if they concentrate on quality. Once the quality is guaranteed, the price and psychological advantage can help them" [12, 14]. They are right: during my visit, I did enjoyed high quality, original taste and variety in authentic Chinese food, however, only in well-recognized and relatively expensive restaurants.

What about the "developed" Western World?

The dramatic food-poisoning epidemic in Germany that started in May 2011 in the northern part of the country caused by an entero-haemorrhagic strain of *Escherichia coli* (EHEC) was a severe accident. Four thousand sick people and 53 deaths were the devastating result of this epidemic, and days and weeks were necessary to trace the source, which was EEHC contaminated fenugreek seeds imported from Egypt, and grown in the country by a food producing company and private persons (http://www.bfr.bund.de/de/ehec_ausbruch_2011-128212.html). What about the use of the "omics" technologies in nutrition, food technology, food biotechnology and for assessment of food safety? There are several groups working on this topic, results of which have been summarized in a recent book [15] and special issues of specialized journals [16]. As if to emphasize the role of omics, "foodomics" was coined in 2012 and has gained widespread usage since then [17].

Although microorganisms are indispensable for the function of the human digestive tract, and have been used for millennia as necessary tools in food technology and biotechnology [18], the above-presented case demonstrates that they and their toxins can also cause severe food-borne illnesses. The "German case" shows that outbreaks of food borne pathogens also appear to be on the rise again in industrialized countries. There has been a shift from traditional problems with food which were mostly of animal origin such as meat, eggs, milk and milk products, to problems with fresh food of plant origin, as well as shellfish, dried products and ingredients, and traditional fermented food products [19].

This perspective brings the opportunity to develop new targets to ensure food safety, which is important for human health as well as for agriculture, food processing and storage. Ensuring food safety in the future will require new methods for identifying, monitoring and assessing foodborne hazards during production, storage, delivery and consumption.

In addition, there has been considerable public interest in investigation of the safety of fungal toxins, toxic chemicals in food and possible changes during the processing of foodstuffs [20]. Any of these areas of interest may be impacted by mycotoxin contamination of the soil, water or air. Poisonings caused by toxic components are sometimes difficult to link to a particular food: the onset of the effects may be gradual and not detected until chronic or permanent damage occurs. Surveillance studies showed that mycotoxin contamination is a worldwide problem, especially in developing countries, where suitable cultivation, processing and storage technologies have had difficulty being implemented [21]. Identification and monitoring of (bio)markers of the most-relevant toxins that have been detected in this type of environment will yield a more accurate risk assessment. New safety risks have to be taken into consideration because of the continuous adaptation of relevant foodborne pathogens and other potentially pathogenic microorganisms, changes in production methodologies, changes in the environment and increases in global trade of foodstuffs. The newest cases of milk contamination by mycotoxins, coming presumably from contaminated animal food in several European countries illustrates the real consequences posed by these risks (http://www.ifa-tulln.ac.at/index.php?id=33&tx_ttnews%5Btt_news%5D=144&tx_ttnews%5BbackPid%5D=7&cHash=3ebf5da4da6dbb128e202d042d53c519).

Adulteration is a relevant concern: the starting materials, e.g. meat, milk, grapes for wine production, and other valuable raw materials are substituted for lower value ones, resulting in an increased profit for producers [12, 13, 22]. After the discussion of the "mycotoxin cases" and the use of possibly multiply frozen meat a couple of years ago mostly in South-Eastern Europe (http://www.spiegel.de/spiegel/print/d-81562346.html, Der Spiegel online), we are repeatedly facing new cases such the

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recent horsemeat scandal (http://www.guardian.co.uk/uk/horsemeat-scandal). Several foodomic methods such as DNA based techniques, spectroscopy (including NMR), sensory methods and bioimaging can be used to combat these problems. Omics methods are also gaining importance in the identification of antibiotics in meat, growth promoters [8, 9], adulteration of raw materials in production of high-value food (for review see: [22] and [23]), and in determining the rate of food spoilage during storage [24]. It has already been demonstrated that previously effective methods of food analysis and detection of adulterants can be further optimized through new, state-of-the-art, more sensitive high-throughput methods (compare [23] and [24]).

Russo *et al.* [24] demonstrated that adulteration of buffalo milk by replacement with bovine milk can be detected by analyses of posttranslation modifications, in this case, casein phosphopeptides. Introduction of this methodology will also be a very useful tool for (phospho) proteomic and genomic meat analysis [25].

With few exceptions [25], glycomic and phosphoproteomic analyses in foodomics are currently limited to milk [9]. Analysis of posttranslational modifications, primarly glycosylation and phosporylation, can be utilized on a much broader scale, outside of scientific investigation, to determine the quality and originality of starting materials, follow changes during food fermentation, and identify typical food adulterations [25]. Additional information about food products can be gained through parallel investigation of phospholipid changes [27].

Figure 1: Application of foodomics to food quality and safety (adapted from D'Alessandro & Zolla, 2012).

The foodomic disciplines are rapidly evolving, filled with technological innovations such as high-throughput sample preparation, optimized LC and MS instruments: bioinformatic tools, in direction of the label-free quantitative MS analysis and other practical issues. The collaboration of all participating groups in foodomics will ultimately result in an integration of all applied omic disciplines, resulting in a more suitable tool than each discipline alone in providing the answers to the questions that are addressed above (see also Figure 1).

The continuing need for food safety and increasing need for protection against adulteration of food products is putting increased demands on food analysts to develop rapid and novel test methods [28-30]. Thus, genomic, proteomic, metabolomic and other foodomic methods will have an important role in the food industry and in public health in ensuring the production of safe and high-quality food in coming years [8, 17, 31, 32].

According to Chinese Officials, together with the environmental issues like heavy pollution, food safety will have the main priority in the strategy for insurance of life quality of Chinese citizens (see also References [11] and [12]).

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