Insights into the nature of food safety issues in Beijing through content analysis of an Internet database of food safety incidents in China

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A B S T R A C T

Beijing, as the capital of the world’s most populous nation, has been at the forefront in food safety management in mainland China. Yet, food safety incidents have frequently occurred. To gain insights into the nature of food safety incidents occurred in Beijing, content analysis was carried out on an Internet database of food safety incidents, the “Throwing out the window net”, which has collected a representative subset of food safety incidents occurred in China since 2001. It is found 1) among the 295 food safety incidents, 150 were issued by governmental agencies, and 145 were reported by news media; 2) the government alone, as an originator, has the highest percentage of 52.5% for exposing the incidents; 3) the types of food involved in food safety incidents mainly include (i) fruits and vegetables, (ii) meat and meat products, (iii) cereals and cereal products, and (iv) confectionery. They account for 19.3%, 18.0%, 14.9%, 13.6%, respectively; 4) the main stage detected for the 295 food safety incidents happened over the past decade is the stage of production and processing, accounting for 73.4%; and 5) human factor is the major underlying cause, accounting for 99% of the cases collected by the database. A little fortunately, the number of food safety incidents caused by fraud is less than those caused by un-intentional human errors. Otherwise, one would have been exceedingly depressed.

1. Introduction

Food safety is obviously crucial to any city. World-wide, there have been considerable efforts to improve food safety. Recent examples of these efforts include a qualitative study of awareness and perceptions of food safety of artisan cheese makers in southwestern Ontario (Le, Bazger, Hill, & Wilcock, 2014), evaluation of the occurrence of Listeria monocytogenes in cheese (Barancelli et al., 2014) and Staphylococcus aureus isolates in milk (Lee et al., 2012) using pulsed-field gel electrophoresis, and assessment of good manufacturing practices (GMP) and hazard analysis and critical control point (HACCP) systems (Cusato et al., 2013; Cusato et al., 2014; Dias et al., 2012; Maldonado-Siman, Bai, Ramírez-Valverde, Gong, & Rodríguez-de Lara, 2014; Lockis et al., 2011).

Food safety is especially important to Beijing, as it strives to become a center of politics, economy and culture in the world. Any serious food safety incident occurred in Beijing would endanger a huge number of people, gravely affect social stability and economic development, and seriously damage the image of Beijing or even China (Jia & Jukes, 2013; Lam, Remais, Fung, Xu, & Sun, 2013; Wu & Chen, 2013). It is thus no wonder that in recent years, Beijing has been at the forefront in food safety management (FSM) in mainland China. In fact, Beijing Municipal Health Bureau found that the overall food safety rate (i.e., the ratio between the number of samples complying to standards and the total number of samples related to food safety) in Beijing reached 97.3% in 2012 (Li, 2013).

Nevertheless, serious food safety incidents still occurred frequently in Beijing. While the most infamous food safety incident in China is perhaps the wide-spread melamine-tainted milk incident occurred a few years ago (Lachenmeier et al., 2009; Lancet editorial, 2009; Lancet editorial, 2012), Beijing did not fare much
better. In fact, in 1998, the overall food safety rate in Beijing was found to be 79.8%, a rather poor figure (Li, 2012). In 2009, from a survey on food safety conducted by the Beijing Municipal of the National Bureau of Statistics, Wang and Tong found that while most residents were satisfied with food in supermarkets, most were worried about the food in restaurants, and only 51.1% of the respondents surveyed believed Beijing’s overall food safety to be acceptable (Wang & Tong, 2009). By 2011, the situation became slightly better, as they found from the 2011 survey that nearly 70% of the respondents considered food in Beijing to be safe (Wang & Tong, 2011). These data suggest that although the government has made some effort to improve food safety, the food safety issue in Beijing remains severe and highly complicated, and the extent of residents’ satisfaction with food safety need to be greatly improved.

Published researches on Beijing’s FSM have focused on a few aspects, including (i) production such as heavy metals pollution (Khan, Cao, Zheng, Huang, & Zhu, 2008), traceability system in the process of vegetable cultivation (Wang & Qiao, 2011), the development of urban vegetable production (Du, Cai, Guo, & Fan, 2012), and the factors of vegetable production in big city (Fan, Mu, & Fu, 2012); (ii) food distribution and consumption such as consumers’ concerns and attitudes (Cheng, Ma, Li, Zheng, & Liu, 2008; Mao & An, 2012; Wang, Zhang, Mu, Fu, & Zhang, 2009) and consumer behaviors (Mao & An, 2012; Wang, Liu, & Wu, 2011; Wang et al., 2009); (iii) supervision such as model of safety supervision (Zhou, 2009) and government provisioning (Ren, An, & Duo, 2011); and (iv) the experiences of ensuring Beijing Olympic food safety (Cai, 2009; Wu et al., 2010). Overall, these researches emphasize some sectors of the food supply chain or the administrative experiences of some specific events.

To broaden the scope of research on food safety incidents in China, recently, Qiang, Wen, Jing, and Yue (2011) have taken a significant step forward, by employing content analysis to analyze the food safety reports collected over a three month period in 2009 in China, from April 1st to June 30th. Among the more interesting features they have found are (i) only 20% of the reports contained the penalty information, (ii) 8% of the reports contained potential hazard information, and (iii) over 50% of the reports contained food types and violation rate information.

The study of Qiang et al. (2011), while enlightening, suffers from two limitations: (1) the observation period is short, and (2) the collected reports on food safety sometimes do not contain enough information for thoroughly studying food safety issues. To remedy these problems, we use an Internet database of food safety incidents, the “Throwing out the window net”, which has collected a representative subset of food safety incidents occurred in China that the government wants the society to know. Our focus will be to find the main causes of food safety issues in Beijing so that effective strategies could be developed to curb further occurrence of food safety incidents in Beijing and China.

2. Data and methods

2.1. Data source

The data analyzed here comes from the “throwing out the window net” (http://www.zccw.info/), a food safety incidents database in China, which has been created by 34 volunteers with sponsorship from Wu Heng. The volunteers, most of them being young and from worldwide, are experts in web crawling. Wu Heng is from the consumer interest group. He built the website at his own expense to expose the dark-side of food safety issues to the public. The website has been reported by more than 20 authoritative media in China, such as CCTV, Xinhua net, NF daily and so on. The database is formed by searching 17,268 open reports, with the theme on contaminated food, covering all mainland China since 2001. By 2012, the website had collected more than 3000 food safety incidents throughout China. Therefore, the food safety incidents collected by the net may be considered representative of what the Chinese government wants the society to know. Note that few reports could be found on the net before 2004. This amounts to under-reporting. The reason is, even though as many food safety incidents were reported on news media before as after 2004, much fewer could be found on the Internet before 2004. This motivates us to focus on the data since 2004.

In this study, we have extracted all food safety incidents occurred in Beijing from January 1st, 2004 to August 1st, 2013. Obviously, the time series of food safety incidents, having a 10 year period, is relatively long. The raw data we collected from the website contained some completely irrelevant information and incomplete information. Preprocessing data is to remove the completely irrelevant information and add the missing information. After data preprocessing, the total number of food safety incidents in Beijing is 295. Therefore, about 10% of the food safety incidents were in Beijing, since there were only about 3000 incidents collected on the net throughout China. Beijing’s population is only 1.6% of the total population in China. Therefore, this number, 10%, is rather high (please also see a figure at www.zccw.info/repo rt/2). To reconcile with the perception that Beijing has been at the forefront in FSM in mainland China, we have to interpret “forefront” as reporting food safety incidents more comprehensively.

2.2. Methods

To best reveal the underlying cause of food safety incidents in Beijing and China, we have to adopt an entirely different rationale and approach than “orthodox ones” for studying food safety risk factors. While “orthodox” approaches would focus on chemical and biological factors, we will focus on behavioral aspects of food safety incidents. More specifically, we ask whether food safety incidents are caused by intentional human factors.

To achieve our goal, we employ content analysis to analyze food safety incidents occurred in Beijing (Qiang et al., 2011). Content analysis is a method widely used in social sciences for studying the content of empirical documentation. Specifically, it transforms a non-systematic qualitative symbolic content, such as texts, images, etc., into a systematic quantitative data (Joubish & Khurram, 2011; Mayring, 2000). It enables researchers to analyze large amounts of textual information and systematically identify its properties, such as the frequencies of most used key words. In our study, generalizing the literature on food safety issues (Jia & Jukes, 2013; Lam et al., 2013; Wu & Chen, 2013), we have focused on 7 key features, including the occurrence time, the report types and information source, the originators, the main food categories, food chain, the apparent causes, and the underlying cause.

2.2.1. Coding

As an important step of content analysis, coding can help us systematically classify the key features from a large number of textual information. In this paper, we classify the texts of 295 food safety reports in Beijing (Qiang et al., 2011). The details are shown in Table 1. The sub-categories are classified according to CODEX GENERAL STANDARD FOR FOOD ADDITIVES.

During the encoding process, a manual method, involving the first two authors of the paper separately, is used to code 295 food safety incidents in Beijing. It consists of the following steps. Firstly, the text data were extracted from food safety incidents reports using content analysis. In the process of extracting, 7 variables of key features are selected. Secondly, two authors encoded all 295
Table 1
List of the key features used in coding.

<table>
<thead>
<tr>
<th>Key features</th>
<th>Sub-categories</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occurrence time</td>
<td></td>
<td>The specific time a food safety incident is exposed or happened.</td>
</tr>
<tr>
<td>Report types</td>
<td>Bulletin reports</td>
<td>Reports issued by governmental agencies.</td>
</tr>
<tr>
<td></td>
<td>News reports</td>
<td>Reports issued by newspapers.</td>
</tr>
<tr>
<td>Originators</td>
<td>Please refer to Table 2</td>
<td>Those first revealed food safety incidents to the public.</td>
</tr>
<tr>
<td>Food chain</td>
<td>Primary agricultural products</td>
<td>A stage of food chain including plant cultivation and animal breeding.</td>
</tr>
<tr>
<td></td>
<td>Production and processing</td>
<td>A stage of food chain including the production and processing of primarily agricultural products and other foods.</td>
</tr>
<tr>
<td></td>
<td>Storage and transportation</td>
<td>A stage of food chain including the storage and transportation.</td>
</tr>
<tr>
<td></td>
<td>Sales</td>
<td>A stage of food chain involving the distributor and supermarket, etc.</td>
</tr>
<tr>
<td></td>
<td>Restaurant and catering</td>
<td>A stage of food chain involving food served in restaurants/catering units.</td>
</tr>
<tr>
<td>Apparent causes</td>
<td>Non-food raw material item</td>
<td>Non-food raw materials found in food, such as talcum powder, industrial sulfur, caustic soda in food.</td>
</tr>
<tr>
<td></td>
<td>Food additive item</td>
<td>Additives in food which do not comply with food safety standard, such as sweeteners, colorings, preservatives.</td>
</tr>
<tr>
<td></td>
<td>Microorganism item</td>
<td>Microorganism item which does not comply with the food safety standard, such as salmonella in chicken.</td>
</tr>
<tr>
<td></td>
<td>Fake food item</td>
<td>Non-food raw materials used as the main ingredients to fake certain food for financial gain.</td>
</tr>
<tr>
<td></td>
<td>Substandard of hygiene</td>
<td>Substandard of hygiene refers to environmental conditions of food processing which do not comply with the food hygiene standard.</td>
</tr>
<tr>
<td></td>
<td>Substandard of nutrition</td>
<td>Substandard of nutrition means nutrition level does not comply with the food safety standard, such as &quot;low amino acid nitrogen content in soy sauce&quot;.</td>
</tr>
<tr>
<td></td>
<td>Pesticide and veterinary drugs item</td>
<td>Situation where pesticide and veterinary drugs level violates the food safety standard, such as dimethoate in apple.</td>
</tr>
<tr>
<td></td>
<td>Debris item</td>
<td>Food which contains physical impurities, such as glass, stone.</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Any other kinds of violative items such as mislabeling, etc.</td>
</tr>
<tr>
<td>Underlying cause</td>
<td>Human factor</td>
<td>An event is mainly caused by a human factor.</td>
</tr>
<tr>
<td></td>
<td>Non-human factor</td>
<td>An event is not caused by any human factors.</td>
</tr>
<tr>
<td></td>
<td>Man-made intentional</td>
<td>An event is mainly caused deliberatively.</td>
</tr>
<tr>
<td></td>
<td>Un-intentional</td>
<td>An event is not mainly caused intentionally, but by a pure un-intentional human error.</td>
</tr>
</tbody>
</table>

3. Results

3.1. Monthly food safety incidents

We calculated the number of food safety incidents occurred in each month. The result is shown in Fig. 1. We found that the number of food safety incidents exposed in 2005 is the largest, reaching to 84; the number of food safety incidents exposed in 2006 ranks the second, which is 49; in other years, the number of food safety incidents exposed mainly falls between 12 and 36.

3.2. Report types and information source

The bulletin reports were mainly issued by the relevant governmental agencies, such as food safety office, business sector, etc. The news reports were mainly issued by Newspapers, such as Beijing Times, Beijing News, Beijing Evening News, Beijing Morning News, Legal Evening News, Legal Daily, Beijing Daily Messenger, etc. Other sources, including CCTV and other media organizations, also reported some incidents. These are also counted as news reports. The number of the bulletin reports (150) is slightly more than the news reports (145).

3.3. Originators

The government alone, as an originator, had exposed 155 food safety incidents (note that 150 incidents were reported by the government alone, and 5 were re-broadcasted by media based on reports from the government. So in essence, 155 incidents were exposed by the government). This amounts to 52.5% of the total incidents uncovered, thus having the highest percentage of the incidents reported. The media totally managed by its own staff had accounted for 11.5%. The media instigated by consumers had accounted for 19.7%, while the media instigated by the government had accounted for 6.8% (See Table 2). Note that consumers were not allowed to expose food safety incidents all by themselves; they had to do so through the media, the government or other channels. That was the reason that the government and the media were the main originators. Other parties, such as production operators, third-party agencies, etc., were only occasional originators.

3.4. Main food categories

The food categories were classified according to the CODEX GENERAL STANDARD FOR FOOD ADDITIVES 192-1995. The types of food involved in food safety incidents include (i) fruits and vegetables, (ii) meat and meat products, (iii) cereals and cereal products, and (iv) confectionery. They account for 19.3%, 18.0%, 14.9%, 13.6%, respectively. Furthermore, beverages; ready-to-eat savouries; fish and fish products; salts, spices, soups, sauces, salads, and protein products; dairy products; bakery wares; composite foods; fats and oils, and fat emulsions; egg and egg products; foodstuffs intended particular nutritional uses; edible ices, including sherbet and sorbet are also involved in some food safety incidents (See Table 3). Baby food, defined here as some soft, easily consumed food, such as cereal products, for children roughly below three years of age, accounts for 9.5%. It belongs to the categories of dairy products, cereals and cereal products, confectionery and foodstuffs intended for particular nutritional uses. It is cared very much by the general public.

3.5. Food chain

From farm to table, there are five stages in the food chain. The main stage detected for the 295 food safety incidents happened over the past decade is the stage of production and processing. It
involved 215 incidents, thus accounting for 73.4%. Other stages, such as sales, restaurants and catering, primary agricultural products, and storage and transportation, accounted for 11.9%, 8.1%, 3.4%, and 3.1%, respectively.

3.6. Apparent causes

The main hazards of food safety incidents occurred in the past decade include food additive item, microorganism item and fake food item, which account for 43.4%, 23.4%, 18.0%, respectively. Please see Table 4. Note that the summation of the entries in Table 4 is larger than 100%. This is because some incidents may involve more than 1 "item". In particular, we note that non-food raw material item mainly includes non-food raw materials which cannot be eaten, such as talcum powder, industrial sulfur, caustic soda. Food additive item mainly includes sweeteners, colorings, preservatives. The 3 most important causes of microbial contamination are *Escherichia coli*, Salmonella, and Listeria. Fake food item refers to using non-food raw materials as the main ingredients to make into fake food and deceive consumers and for financial gain such as fake soy sauce, fake vinegar, fake milk. Furthermore, substandard of hygiene, substandard of nutrition, pesticide and veterinary drugs item, and debris item are also involved in some food safety incidents (See Table 4). Assaying these problematic foods finds that the number of food safety incidents involving chemical factors is 217, accounting for 73.6%, while that involving biological factors is 131, accounting for 44.4%. Therefore, there are 53 incidents that have involved both chemical and biological factors. Essentially no or few physical factors have been found in these incidents. The incidents involving chemical factors are mainly due to illegally added non-food raw materials or excessive use of additives by the producer.

3.7. Underlying cause

Going beyond analyzing chemical and biological factors involved in the food safety incidents, we find a deeper cause, that is, most of the food safety problems are caused by human beings. Specifically, the number of food safety incidents caused by human factors (HF) alone is 255, accounting for 86.4%; the number of incidents caused by both human and non-human factors (NHF) is 37, accounting for 12.5%; the number of food safety incidents caused by purely NHF is only 3, close to 1.0%. Therefore, 99% of the cases have involved HF. We thus may conclude that human factors are the main or the underlying cause of the majority of the reported food safety incidents in Beijing.

We have further found that the number of food safety incidents caused by un-intentional human errors is more than those by intentional human behaviors. Specifically, the number of food safety incidents caused by un-intentional errors alone is 169, accounting for 57.9%; the number of food safety incidents caused by man-made intentional alone is 75, accounting for 25.7%; the number of incidents involving both un-intentional errors and man-made intentional behaviors is 48, accounting for 16.4%. Therefore, the number of food safety incidents by un-intentional (217) human errors is significantly higher than that by man-made intentional (123) human behaviors.

4. Concluding discussions

In this paper, using content analysis on the food safety incidents occurred in Beijing in the past decade, which have been collected by an Internet database called “throwing out the window net”, it is found 1) among the 295 food safety incidents, 150 were issued by governmental agencies, and 145 were reported by news media; 2)
the government alone, as an originator, has the highest percentage of 52.5% for exposing the incidents; 3) the types of food involved in food safety incidents mainly include (i) fruits and vegetables, (ii) meat and meat products, (iii) cereals and cereal products, and (iv) confectionery. They account for 19.3%, 18.0%, 14.9%, 13.6%, respectively; 4) the main stage detected for the food safety incidents is the stage of production and processing, accounting for 73.4%; and 5) human factor is the major underlying cause, accounting for 99% of the cases collected by the database.

How significant are our findings? To answer this, we have to consider whether the “throwing out the window net” is an important database or not. It turns out that up to now, the “throwing out the window net” is the first and the only warning website about contaminated food in China. Albeit so far it has only collected about 3000 food safety incidents over a ten year period, which is much smaller than 20,000 major food poisoning incidents considered to occur annually in China (Xu, 2011; Wu, 2013), since fractions in China may be too creative and too numerous for inspectors to identify. For this reason, we have found that human factor is the major underlying cause, accounting for 99% of the cases collected by the database.

Table 4
The apparent causes of food safety incidents exposed in Beijing.

<table>
<thead>
<tr>
<th>Hazard types</th>
<th>Number</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food additive item</td>
<td>128</td>
<td>43.4%</td>
</tr>
<tr>
<td>Microorganism item</td>
<td>69</td>
<td>23.4%</td>
</tr>
<tr>
<td>Fake food item</td>
<td>53</td>
<td>18.0%</td>
</tr>
<tr>
<td>Substandard of hygiene</td>
<td>29</td>
<td>9.8%</td>
</tr>
<tr>
<td>Non-food raw material item</td>
<td>27</td>
<td>9.2%</td>
</tr>
<tr>
<td>Substandard of nutrition</td>
<td>21</td>
<td>7.1%</td>
</tr>
<tr>
<td>Pesticide and veterinary drug item</td>
<td>12</td>
<td>4.1%</td>
</tr>
<tr>
<td>Debris item</td>
<td>12</td>
<td>4.1%</td>
</tr>
<tr>
<td>Others</td>
<td>9</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

all the relevant parties in China to systematically implement these systems in all areas of food industry, to improve food safety.

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