



Knowledge of food safety and handling in households: A survey of food handlers in Mainland China



Shunlong Gong^a, Xizhuo Wang^b, Yinsheng Yang^c, Li Bai^{c,*}

^a School of Management, Jilin University, 5988 Renmin Street, Changchun 130022, PR China

^b Chinese Academy of Agricultural Engineering, Beijing 100125, PR China

^c Key Laboratory of Bionic Engineering, Ministry of Education, Jilin University, 5988 Renmin Street, Changchun 130022, PR China

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ABSTRACT

The objective of the study was to provide a picture of knowledge of food safety and handling in households and identify a demographic profile of “high-risk” groups with the poorest knowledge. A national survey of food handlers in Mainland China ($n = 482$) was conducted using previously validated closed questionnaires. The questionnaire consisted of 26 knowledge questions, which included 5 scales that covered key concepts of food safety and handling in households, and 7 demographic questions. The respondents demonstrated a very low level of knowledge and the mean score awarded to them was 7.95 (knowledge scores from 0 to 26). The data were further analyzed to determine differences in knowledge between populations of different demographics. Differences were found between male and female respondents ($p < 0.01$), urban and rural respondents ($p < 0.01$) and respondents with different income levels ($p = 0.04$). Two “high-risk” groups with the lowest level of knowledge are 1) male food handlers with a per capita annual income of less than 30,000 CNY (4773 USD) and 2) female food handlers who live in rural areas and have a per capita annual income below 30,000 CNY (4773 USD) and deserve special attention. This is the first national survey in Mainland China and the results suggested that developing educational programs related to food safety and handling in households of Mainland China are urgently needed.

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1. Introduction

Food safety is one of the important issues that have emerged during the socio-economic development of China. To ensure the safety of food, the entire chain, which includes four links – farmers, manufacturers, retailers and consumers – must be involved (Bai, Tang, Yang, & Gong, 2014). Reported incidence of food-borne disease associated with the domestic environment in different countries is greatly variable. Although the actual proportion of food-borne disease cases that occur in the home is likely to be much larger than reported outbreak data suggests, data of reported food-borne suggest that a significant proportion of food-borne illness has been attributed to improper food processing in households (Redmond & Griffith, 2003). Data from Australia and New Zealand suggested that 20–50% of food-borne illness was attributed to the

home (Redmond & Griffith, 2009). In the European Union (EU), 36.4% of reported food-borne outbreaks were caused by improper food handling practices in households, followed by 20.6% in restaurants, cafés, bars and hotels, and 5.5% in schools and kindergartens (EFSA, 2011). In the United States, during 2009–2010, among the 766 outbreaks with a known single setting where food was consumed, 21% were caused by food consumed in a private home (CDC, 2013).

In mainland China, 50.6% of the reported food poisoning cases and 85.5% of the deaths were attributed to food that was prepared at home during the year of 2014 (NHFPC, 2015). During the period from 1999 to early 2010, 24.4% of the 2387 reported food poisoning outbreaks in Mainland China were caused by food consumed in the home, followed by 23.4% in restaurants, 15.2% in school cafeterias, 12.4% in company cafeterias, and 9.6% in rural family banquets (Xue & Zhang, 2013). Of the incidents that occurred in households, there were 265 deaths, equaling about 70% of the total deaths, and 67 of the deaths were caused by deadly bacteria (44 by *C. botulinum*, 10 by *B. cocovenenans* and 13 by all other bacteria) (Xue & Zhang, 2013). In Mainland China, *Salmonella* and *Vibrio parahaemolyticus*

* Corresponding author.

E-mail addresses: gsl@jlu.edu.cn (S. Gong), bai_ly@126.com, bl@jlu.edu.cn (L. Bai).

have been found the most common causes of bacterial food poisoning in households during the past two decades (Li, 2012; Wu, Wen, Ma, Ma, & Chen, 2014).

Knowledge itself does not always result in positive practices since the relationship between knowledge and practice was found to be mediated by other variables (Ko, 2013); however, there is a general consensus that food handlers must master adequate knowledge to prevent microbiological contamination in households (Jevšnik, Hoyer, & Raspor, 2008; Meysenburg, Albrecht, Litchfield, & Ritter-Gooder, 2014; Mortlock, Peters, & Griffith, 1999). A lack of knowledge of food safety and handling in households was considered as one of the barriers to food handlers practicing food safety (Meysenburg et al., 2014; Xue & Zhang, 2013). Al-Sakkaf (2012) declared that a lack of knowledge during domestic food preparation is possibly the reason for the higher rate of campylobacteriosis in New Zealand. Mullan and Wong (2010) proposed that domestic food safety education must target not only social cognitive determinants but also knowledge since the change of domestic food safety behavior without knowledge is unlikely.

Designing an educational program targeted at improving food handling knowledge should be based on understanding the actual level of food handlers. Identifying the demographic characteristics of the groups with the lowest knowledge level is the baseline from which to build an educational program. Many researchers worldwide have identified the demographic characteristics of social classification, education level, age, income, gender, and residential location as potentially playing a role in determining food handling knowledge to prevent microbiological contamination by food handlers in households (Gong et al., 2011; Hassan & Dimassi, 2014; Migliorati et al., 2015; Ovca, Jevšnik, & Raspor, 2014; Sanlier, 2009; Unusan, 2007). These studies show varied results, which may in part be due to variations in study designs, study populations, and survey questions. However, despite the importance of this issue, a survey of the literature indicated that to date no study has been conducted on the knowledge of food handlers in households of Mainland China; also, no government-sponsored educational programs have been provided on this topic in Mainland China.

In view of this need, this paper has two primary goals: 1) to provide a picture of knowledge of food safety and handling in households based on a national survey of food handlers in Mainland China; and 2) to identify a demographic profile of "high-risk" groups with the poorest knowledge. This paper aims to provide practical guidance for designing targeted educational programs.

2. Material and methods

2.1. Questionnaire design

A questionnaire that composed of two sections was developed in order to assess the knowledge of food safety and handling in households of Mainland China. The first section of the questionnaire was developed by the researchers to collect information about consumers' demographic characteristics. The second section was developed based on the reliable and valid questionnaire in the published literature to assess consumers' knowledge of food safety and handling in households (Byrd-Bredbenner et al., 2007; Hassan & Dimassi, 2014; Kennedy et al., 2005; Lazou, Georgiadis, Pentieva, Mckevitt, & Iossifidou, 2012; Osaili, Obeidat, Jamous, & Bawadi, 2011; Unusan, 2007). Appropriate modifications were made to some of the selected questions, as regards adjustments to specific eating habits in Mainland China. The questionnaire was subjected to a pilot test to assess its clarity, the suitability of wording, and the average time needed for its completion. Based on the principle of

theoretical saturation (Glaser, 1965), we continued interviewing consumers in Changchun city, Northeast of China and analyzing their responses until no new modification were identified. A total of twenty consumers tested the questionnaire and fourteen of them contributed to its modification, whereas their responses were not included in the final survey.

Finally, the questionnaire consisted of 2 sections and 33 questions. The first section of demographic characteristics included 7 multiple choice questions that surveyed gender, residence, age, per capita annual income, marital status, educational level and whether living with parents. The second section, i.e. knowledge section, included 26 multiple choice questions (five allowed more than one choice) and was grouped into 5 subsections: knowledge of food storage (6 questions), knowledge of food handling (4 questions), knowledge of usage and maintenance of kitchen facilities (6 questions), knowledge of personal hygiene (5 questions) and knowledge of food poisoning (5 questions). Among the 26 questions in the final questionnaire, 24 were directly selected from the reliable and valid questionnaire in the published literature and 2 questions, which were designed to assess consumers' knowledge about the common food sources of food-borne disease pathogens, were adjusted as regards to specific eating habits in Mainland China. The questionnaire took approximately 20–30 min to be completed.

To further assess the stability of the questionnaire, ten consumers in Changchun city, Northeast of China were re-interviewed again by telephone by a different interviewer after three days of the first survey and were required to offer answers to ten questions that were randomly selected from the questionnaire. A minimal interval of 3 days was selected to minimize recollection bias and ten questions were randomly selected at the second interview to minimize sequence bias. The scores of the ten questions on the two occasions were compared using SPSS 21.0 (SPSS Inc., 2012) and the Pearson Correlation between these two sets of scores is 0.879 ($P < 0.01$), indicating that the instrument in the study has a high test-retest reliability.

2.2. Data collection

A non-probabilistic sample of 640 adults over 18 years old, primary food handlers and having prepared food in households at least two times in the past two days was interviewed. These participants located in 16 regions that were randomly selected from the 31 governing regions of Mainland China. To reduce a potential non-coverage bias, a sampling frame covering age, gender, and educational level was used.

The participants were approached in a non-systematic way. The interviewers explained the objectives of the survey, ensured the anonymity and confidentiality and get their consent. Ethical approval was obtained from the Academic Committee of the School of Biological and Agricultural Engineering, Jilin University. In the rural area, the participants were visited and surveyed in their households. Since a large percentage of the population in the rural area is illiterate or semiliterate, the interviewers read out questions and the given choices loud to the participants and help complete the questionnaire. The face-to-face interview usually took about 30 min. In the urban area, the interviewers visited consumers in large shopping centers and the participants were asked to complete the questionnaire independently within 30 min and return it to the reviewer. The location of large shopping centers was selected due to the intense circulation of individuals and because the authors managed to get permission to carry out the data collection from those responsible for these locations. Furthermore, since several studies indicated that students belonged to the groups that severely lack knowledge of food

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