



Consumer knowledge concerning safe handling practices to prevent microbiological contamination in commercial restaurants and socio-demographic characteristics, Campinas/SP/Brazil

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ABSTRACT

The objective of the study was to analyze consumer knowledge about safe handling practices to prevent microbiological contamination in restaurants, verifying its relationship with the socio-demographic variables. Three hundred and fifty adults were interviewed in the city of Campinas, Brazil, using a previously validated knowledge measurement instrument. Socio-demographic information was also collected. Basic descriptive statistics and the means comparison test (*t*-student and ANOVA) were applied to the data collected using the 18.0 PASW Statistics software. The mean score awarded to the consumers for their knowledge was 4.3 ± 1.5 (scores from 0 to 10). A comparison of the means showed no significant differences in knowledge between the genders ($p = 0.388$), age ranges ($p = 0.102$), income levels ($p = 0.087$) or with the frequency of eating meals away from home ($p = 0.930$). Subjects with a higher educational level ($p = 0.001$) and graduated in the area of health ($p < 0.001$) had significantly more knowledge than individuals with a low educational level and not graduated in health, respectively. The results reinforced the importance of carrying out educational programs for consumers concerning safe handling practices in restaurants.

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1. Introduction

Restaurants are frequently associated with food borne diseases (Gurudasi & Sheth, 2009; Haapala & Probart, 2004). Some studies have suggested that consumers use a variety of informational signs concerning food safety when they judge and choose restaurants to eat in. In general, the question of the hygienic conditions of the ambient, utensils and workers has been reported as a factor to be considered in this selection (Fatimah, Boo, Sambasivan, & Salleh, 2010; Sanches & Salay, 2011; Sienny & Serli, 2010). However, consumer perception can frequently be equivocated due to a lack of information concerning the potential risks of restaurant practices. This highlights the need and importance of educating consumers such that they can make safe choices when they eat away from home (Sneed & Strohbahn, 2008).

Various organizations have focused their attention on this type of action, one example being the publication "Restaurant and take-out safety", made available by the Food and Drug Administration (FDA), which highlights the importance of observing the cleanliness of the

establishment, and encourages consumers to choose another restaurant if they are not sure of the hygiene level (FDA, 2005).

For the conception and evaluation of educational programs concerning eating away from home, it is important to identify the level of knowledge of the different consumer groups about handling practices in restaurants. However, no specific studies concerning this subject were found in a review of the literature. Previous surveys analyzed the knowledge of consumers concerning food safety in their own homes (Angelillo, Foresta, Scozzafava, & Pavia, 2001; Gurudasi & Sheth, 2009; Haapala & Probart, 2004; Sharif & Al-Malki, 2010) or of handlers or managers of various catering services (Bolton, Meally, Blair, Mc Dowell, & Cowan, 2008; Jevšnik, Hlebec, & Raspor, 2008).

Thus the objective of the present study was to measure the knowledge of consumers in relation to safe handling practices to prevent microbiological contamination in restaurants, verifying its relationship with socio-demographic variables.

2. Material and methods

2.1. Population and location

A non-probabilistic sample of 350 adults (over 18 years old) was interviewed, all residents in the city of Campinas/SP/Brazil and who

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ate meals away from home. Equivalent numbers of men and women were selected due to the presupposition that differences existed between the genders with respect to their knowledge. The individuals were approached in a non-systematic way, and interviewed face-to-face in about 15 min, after explaining the objectives of the survey and getting their signed consent. The research protocol was submitted to and approved by the Ethics Committee for Research with Human Beings of the Faculty of Medical Sciences, University of Campinas (UNICAMP) (Protocol number 1062/2008). The locations chosen for the survey were a bus terminal ($n = 175$) and a shopping center ($n = 175$) in the city, 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. The interviews were carried out between the months of April and June of 2010 by the first author of this paper and by undergraduate students of the Faculty of Agricultural Engineering, who were trained based on the previously elaborated "Interviewer's Manual".

2.2. Instrument

The degree of knowledge was measured using a validated scale (Uggioni & Salay, *in press*). The instrument consisted of 23 multiple-choice items (each with three or five reply options including the option "I don't know"), grouped into five domains: 1) Food handlers' hygiene; 2) Food acquisition and storage; 3) Food pre-preparation and preparation; 4) Installation and utensil sanitization and 5) Food display. Questions related to the socio-demographic characterization of the individuals were also included in the questionnaire.

2.3. Statistical analysis

The data were grouped in a data bank, and analyzed using the Predictive Analytics Software (PASW Statistics) version 2010. 18.0

Table 1
Characteristics of the consumers (descriptive statistics) and results of the comparison of their knowledge in relation to safe practices in restaurants and the characteristics of the individuals ($n = 350$), Campinas/SP/Brazil, April to June/2010.

Variables	<i>n</i>	%	Grade for knowledge ^a	Standard deviation	Median	<i>p</i> -value
Gender						
Masculine	175	50	4.2 A	1.6	4.3	0.388
Feminine	175	50	4.4 A	1.5	4.3	
Educational level						
Fundamental/High school incomplete	41	11.7	3.8 B	1.2	3.9	0.001*
High school complete	94	26.9	4.1 B	1.6	4.1	
University incomplete	94	26.9	4.1 B	1.3	3.9	
University complete	67	19.1	4.7 A	1.4	4.8	
Post-graduation	54	15.4	4.7 A	1.7	4.3	
Monthly family income						
No income/Up to 2 SM	56	16.0	4.2 A	1.2	4.1	0.087
From 2 to 5 SM	70	20.0	4.1 A	1.5	4.1	
From 5 to 10 SM	70	20.0	4.2 A	1.5	3.9	
From 10 to 15 SM	29	8.3	4.2 A	1.6	4.3	
More than 15 SM	41	11.7	4.9 A	1.8	5.2	
Age (years)						
18–24	127	36.3	4.1 A	1.4	3.9	0.102
25–39	130	37.2	4.3 A	1.5	4.3	
40–50	53	15.1	4.5 A	1.7	4.3	
Over 50	40	11.4	4.6 A	1.5	4.8	
Graduation in an area of health						
Yes	48	13.7	5.2 A	1.8	5.2	<0.001*
No	302	86.3	4.2 B	1.4	3.9	
Frequency of eating meals away from home (times per week)						
1–2 times	79	22.6	4.4 A	1.6	3.9	0.930
3–5 times	155	44.3	4.3 A	1.5	4.3	
More than 5 times	116	33.1	4.3 A	1.5	4.3	
Total knowledge	350	100	4.3	1.5	4.3	

*Significant at the 1% level.

SM = Household minimum wage. 1 SM = Reais \$ 510.00 (at the time of the interviews this equaled US\$ 288.13).

^a Means with the same letters do not differ significantly from each other.

and the XLSTAT software version 2006.06. The data on knowledge and the socio-demographic variables were analyzed using basic descriptive statistics, and ANOVA and the *t*-test were used to verify the significant differences ($p \leq 0.05$) between the groups of individuals interviewed. The Kolmogorov–Smirnov test was employed to verify the normality of the data. The total score for the knowledge of each individual was composed of the sum of the right answers for the 23 questions of the instrument, in which a right answer was scored as equal to 1 and a wrong answer equal to 0. The scores were converted into a grade from 0 to 10.

3. Results and discussion

3.1. Knowledge concerning safe food handling practices and socio-demographic variables

In the sample constituted of 350 consumers (175 men and 175 women), the age ranges with the highest percentages were from 18 to 24 (36.3%) and from 25 to 39 (37.2%). The majority of the subjects (84.6%) had at least completed their undergraduate university education, and 56% had a monthly income of up to 10 minimum salaries. With respect to meals, approximately 67% of them ate away from home up to 5 times per week. It can be seen that 86.3% of the sample was not graduated in the area of health (Table 1).

The data on knowledge followed a normal distribution ($KS = 0.025$; $p > 0.150$), and the internal consistency of the instrument (evaluated by the KR₂₀ (Kuder–Richardson) index) was considered to be adequate (0.66) (Uggioni & Salay, *in press*).

The grades obtained by the individuals varied from 0 to 8.7 with a mean of 4.3 ± 1.5 . The mean percentage of right answers to the questions was 44%, indicating that the consumers did not have adequate knowledge about safe practices. On analyzing the results obtained for the quartiles of the population, the maximum grade in

the first quartile was 3.5, and in the third quartile the grades were at least 5.2.

Although there are no studies measuring the knowledge of consumers with respect to handling practices in restaurants, other studies showed that, in general, consumers had insufficient information on food acquisition, conservation, storage and cooking practices for use in their own homes, or even concerning questions related to the cleaning and disinfection of the food and the ambient and with respect to personal hygiene (Redmond & Griffith, 2003; Sanlier, 2009). A study carried out by Haapala and Probart (2004) analyzed the knowledge of students concerning food safety practices, and found a mean grade of 7.2 ± 1.6 (grades varying from 0 to 10). Bas, Ersun, and Kivanç (2006) analyzed the knowledge of 764 food handlers from various food service segments in Ankara, Turkey with respect to safe handling practices in restaurants. The percentage of right answers given by the handlers was $43.4\% \pm 16.3$, similar to the value found in the present survey.

With respect to the present study, there were no significant differences between the genders ($p = 0.388$), age ranges ($p = 0.102$), income categories ($p = 0.087$) or with respect to the frequency of eating away from home ($p = 0.930$). However, subjects with a higher educational level showed a significantly higher level of knowledge than those with a lower educational level ($p < 0.001$) (Table 1). The same was observed with respect to graduation in an area of health ($p < 0.001$) (Table 1). On analyzing the domains of knowledge separately, no significant differences were observed between the genders in domain 1 (food handlers' hygiene), 2 (food acquisition and storage), 3 (pre-preparation and preparation) or 5 (food display). However in domain 4 (installation and utensil sanitization), the knowledge of the female gender was significantly inferior to that of the masculine gender ($p = 0.045$). With respect to educational level, significant differences were only noted in domain 3 ($p = 0.045$) and in domain 2 ($p = 0.018$). The subjects who had a higher educational level (complete graduation and post-graduation), obtained higher grades in these domains than the individuals who had a lower educational level. No significant differences were found in any domain with respect to income ranges, age ranges and the frequency with which meals were eaten away from home. With respect to domains 1 ($p = 0.015$), 2 ($p = 0.005$) and 3 ($p = 0.001$), consumers graduated in the area of health had significantly more knowledge than consumers with no such graduation, but not in the case of domains 4 and 5.

Various studies have found significant differences in the knowledge of food safety between the age ranges and genders (Byrd-Bredbenner et al., 2007; Patil, Cates, & Morales, 2005; Sanlier, 2009). For example, Patil et al. (2005) analyzed 20 studies related to the consumer and food safety, and concluded that, in general, women had more knowledge than men, and young adults less knowledge than middle-aged adults. The survey carried out by Byrd-Bredbenner et al. (2007) found similar results with respect to greater knowledge being attributed to women. According to Sanlier (2009) various studies carried out with adults have indicated that the knowledge of food safety tends to increase with age, as seen in the present study. This author carried out his survey on safe handling practices in the home, amongst young and adult consumers in Turkey. The results showed a mean grade for knowledge of 5.81 ± 1.43 amongst young consumers (14–19), and of 8.01 ± 1.86 amongst adults (above 20), data in agreement with those observed in the present study, that is, older individuals presented higher grades for knowledge, despite the fact that the difference was not statistically significant. Patil et al. (2005) showed that subjects with a lower educational level, or up to the complete high school level, showed a lower level of knowledge with respect to food safety, data confirmed in the present survey. The results of the studies of Stonerook, Wolf, Bartlett, and George (1999) and of Sharif and Al-

Malki (2010) corroborated with those of the present survey with respect to greater knowledge on the part of those graduated in the area of health. Sharif and Al-Malki (2010) showed that students studying in this area showed higher means for correct answers than those in the areas of humanities. Stonerook et al. (1999), on analyzing the knowledge of food service managers, observed that managers who were nutritionists or technicians in nutrition presented higher grades than managers graduated in other areas.

3.2. Domains of knowledge

On analyzing the results obtained for the domains of knowledge, it can be seen that the highest grade was obtained for the domain of "Food display", with a mean percentage of right answers of 57.5%. To the contrary, the greatest deficiencies were found for the domain of "Installation and utensil sanitization", for which the percentage of right answers was only 35% (Table 2). The items of the instrument referring to the different domains will be discussed in greater detail below.

3.2.1. Food handlers' hygiene

The results of the analysis for this category showed a grade of 4.0 ± 2.4 with a mean percent of right answers of 40%. On analyzing the items for this domain (Table 2), the greatest percentage of right answers was observed for item 3 (*Which kind of soap must food handlers use to sanitize hands?*), with 77.7% of the sample replying correctly. On the other hand, for question 2 (*Under which of the following health conditions can food handlers not work with food preparation:*), the number of right answers was very low with less than 25% of the individuals replying correctly. Haapala and Probart (2004) also showed that the questions with more right answers were those related to the washing of the hands, indicating good knowledge with respect to this theme, a data also found in the present survey.

3.2.2. Food acquisition and storage

Only 2.9% got all the right answers in the questions of this domain, the mean grade being 4.0 ± 2.4 . Item 8 (*Which of the following foods must have the temperature checked when received by the restaurant?*) (Table 2) was the item showing the highest percentage of right answers (73.1%). For question 9, which was related to the storage time of raw fish under refrigeration, the frequency of right answers was only 29.7%, considered low, and for question 10, only 23.7% indicated the correct temperature recommended for freezing (-18°C). In other studies, amongst which that of Walker, Pritchard, and Forsythe (2003), deficiencies were found in the knowledge of handlers in a region of England, with respect to the correct temperatures for storage in freezers and refrigerators in restaurants. With respect to knowledge concerning safe practices in their homes, Redmond and Griffith (2003) showed that 40–60% of the consumers did not know the correct temperature for refrigeration. However, Abbot, Byrd-Bredbenner, Schaffner, Bruhn, and Blalock (2009) found different results with respect to this theme: 66% of young adults got the right answers for storage and cooking temperatures. With respect to the correct storage temperature for foods in the refrigerator (question 7), only 31.4% of the interviewees got the right answer (ready-to-eat foods). Gonzalez et al. (2009) found similar data in a study carried out with food handlers in commercial food restaurants in São Paulo/Brazil. The authors observed that only 20% of the sample got the right answer for this theme.

3.2.3. Food pre-preparation and preparation

With respect to food pre-preparation and preparation, only one consumer got all the right answers, and the average grade for this

Table 2
Descriptive statistics of the domains and items on the consumer knowledge scale in relation to the safe handling practices in restaurants ($n = 350$), Campinas/SP/Brazil, April to June 2010.

Domains & items	Correct answers		
	Frequency	Percentage (%)	Mean score (SD) ^a
Domain 1: Food handlers' hygiene	140	40	4.0 (2.4)
1. Which of the following items can food handlers not use during meal preparation	144	41.1	
2. Under which of the following health conditions can food handlers not work with food preparation:	51	14.6	
3. Which kind of soap must food handlers use to sanitize hands?	272	77.7	
4. Which materials are best for food handlers to dry hands?	100	28.6	
5. Indicate all the situations under which food handlers have to sanitize their hands:	150	42.9	
6. Indicate all practices that are forbidden for food handlers during meal preparation:	125	35.7	
Domain 2: Food acquisition & storage	139	39.5	4.0 (2.5)
7. Which kind of food should be stored on the superior shelves of the refrigerator?	112	32.0	
8. Which of the following foods must have the temperature checked when received by the restaurant?	256	73.1	
9. What is the ideal period of time for raw fish be stored under refrigeration at 4 °C?	104	29.7	
10. What is the ideal food temperature in restaurant freezers?	83	23.7	
Domain 3: Food pre-preparation and preparation	143	41	4.1 (2.0)
11. The food sanitization process is comprised of these steps: wash the product in running tap water, immerse the product in bleach solution and rinse the product in running water. Indicate the following foods that don't need to be sanitized:	157	44.9	
12. How long should one immerse lettuce in a bleach solution for, in order to sanitize it?	93	26.6	
13. Which is the best way to de-frost food?	204	58.3	
14. Regarding ready-to-eat food that was de-frosted but not totally used:	217	62.0	
15. Can the same cutting board be used for raw and cooked vegetables?	189	54.0	
16. Which egg types must be used in raw desserts?	44	12.6	
17. During food preparation, which situations require the mandatory use of disposable gloves?	102	29.1	
Domain 4: Installation and utensil sanitization	122	35	3.6 (3.2)
18. With which of the following products, must the kitchen floor be sanitized daily:	194	55.4	
19. Regarding restaurant utensil cleaning, identify the inappropriate practices:	57	16.3	
Domain 5: Food display	200	57.5	5.8 (2.8)
20. How should the meal item be re-positioned in a self-service display balcony platter?	222	63.4	
21. How long can heated food (at 60 °C) in the distribution display be exposed for consumption?	191	54.6	
22. Can food left over from the self-service display be replaced in the display the next day?	255	72.9	
23. When serving themselves from a display unit, which consumer behavior can contaminate food?	138	39.4	

^a SD = standard deviation.

domain was 4.1 ± 2.0 . Knowledge of the correct way to hygienize foods was measured by two questions: 11 (*Indicate the following foods that don't need to be sanitized:*) and 12 (*How long should one immerse lettuce in a bleach solution for, in order to sanitize it?*), with percentages of right answers of 44.9% and 26.6%, respectively (Table 2). In the case of the use of a chlorinated solution, the majority of the sample either did not know about this practice or underestimated the time of permanence of the foods in this solution. Failures in the correct hygienization of foods were also mentioned by Gonzalez et al. (2009), who found a percentage of right answers of 19% for this theme. The authors also observed that 49.2% of handlers knew they should use the chlorinated solution, although the majority did not leave the foods in the solution long enough. One point to be highlighted is the understanding of consumers with respect to terms considered basic for professionals in this area, such as chlorinated or disinfecting solutions. A survey carried out by Redmond and Griffith (2003) showed that 44% of the consumers did not understand terms such as "disinfectant", for example. This data could justify the low knowledge found with respect to these questions in the present study.

With respect to the thawing of foods (question 13), 57.7% of the consumers indicated that this was best done in the refrigerator. The results found corroborated with the survey of Mac Carthy et al. (2007), who, on studying the knowledge of Irish consumers with respect to safe handling practices in their homes, observed that 61% of the interviewees knew that food should be thawed in the refrigerator. In a study carried out by Bolton et al. (2008), 63% of the kitchen chefs in Ireland thawed food correctly in the refrigerator. With respect to cross contamination (use of different cutting boards

for raw and cooked foods), 54.8% of the consumers indicated you should not use the same board. These data agree with those of other studies, such as that of Bas et al. (2006), who found that the questions related to cross contamination were correctly replied to by slightly over half the interviewees, with means for the right answers of 53.4 ± 19.2 (100 points), as found in the present survey. Data presented by Redmond and Griffith (2003) showed that more than 22% of consumers in the USA and more than 36% in England, did not consider it important to use different utensils to handle raw and cooked foods in their homes. However, other studies found higher percentages for the correct answers with respect to cross contamination. For example, Abbot et al. (2009) observed that a sample of young adults obtained 63% of right answers, and Patil et al. (2005) showed that consumers had good knowledge (86%) with respect to the prevention of cross contamination. Question 16 showed less than 25% of right answers, indicating low knowledge by the consumers of the most adequate types of egg to use. However, 87.7% of the sample ticked the option "raw eggs", indicating that they know about the risks of consuming this food. Sharif and Al-Malki (2010) analyzed the knowledge of students about unsafe practices that could contaminate foods, and observed that more than 50% were unaware of the prejudices related to the consumption of raw eggs. In the present survey, the results were the inverse, with the consumers appearing to be aware of the risks of this practice.

3.2.4. Installation and utensil sanitization

The results showed that the mean grade for the questions related to the domain "Installation and utensil sanitization" was 3.6 ± 2.8 , with 38% not getting the right answer for either of the 2 questions

related to this theme, showing the difficulty of the consumers in this respect. Item 19 (*Regarding restaurant utensil cleaning, identify the inappropriate practices:*) presented a percentage of right answers of 16.3% (Table 2).

3.2.5. Food display

The mean grade for the domain “Food display” was 5.8 ± 2.8 , considered the highest amongst the other domains of the scale, indicating greater knowledge of this theme by the consumers. The highest percentage of right answers was observed for item 22 (*Can food left over from the self-service display be replaced in the display the next day?*), with a percentage of 72.9% (Table 2). With respect to the behavior of consumers when serving themselves from the counter (question 23), 39.4% got the right answers for behaviors that could contaminate the food. However, Zandonadi, Botelho, Savio, Akutsu, and Araujo (2007), on analyzing the behavior of consumers in this situation, observed that 98% of the consumers failed to wash their hands before serving themselves, 50% used the same utensil used to serve one preparation to serve another, and 53% were chatting over the preparations. The results indicated that the consumers had a notion of the risks of contamination, although their behaviors did not indicate such knowledge.

4. Conclusions

The results obtained in the present survey agree with those of other studies that highlight that the consumer has insufficient knowledge about questions related to food safety. With respect to knowledge on safe handling practices in restaurants, this is directly related to the educational level and to whether the consumer has some graduation in an area of health. As in other similar studies, a lack of knowledge on the part of young adults was observed, which is of concern, since, according to various authors, this sector of the population presents behaviors classified as of risk with respect to both food consumption and food handling. It must be pointed out that an educational program, in addition to giving priority to the public with less knowledge, should focus on the topics where deficiencies were found. In the population studied, the greatest failures were observed in the domains of “Installation and utensil sanitization”, “Food handlers’ hygiene” and “Food acquisition and storage”. In these cases, the need to inform the consumer of the seriousness of food contamination due to handling is apparent, and the consumer should also be informed concerning aspects of temperature control during the refrigerated storage of foods.

It should also be highlighted that private and public actions offer the consumer the opportunity to verify the handling of foods in restaurants. One example is the existence of walls or doors with a small window in restaurant kitchens, which allows the client to visualize the production; another is the government regulation that guarantees the right of the consumer to visit the restaurant kitchen, as is the case in various countries, including Brazil.

These initiatives are relevant, but for the consumer to effectively judge the adequacy of locations to frequent, he requires more information on safe practices in restaurants, as shown by the present survey. Thus, food safety education could help consumers choose safer restaurants.

It is relevant to point out that food safety education programs should be evaluated regarding their impact or effectiveness in order to improve further action or eliminate poor resulting programs (Medeiros, Cavalli, Salay, & Proença, 2011; Nieto-Montenegro, Brown, & LaBorde, 2008; Seaman & Eves, 2006). However, there is a lack of studies in this field, in particular for consumer education programs in the context of away from home food consumption. Also, evidence from previous food safety training evaluations

shows limitations, and new research is needed to understand the factors promoting successful programs results (Egan et al., 2007).

In fact, the design and implementation of an effective education program is complex. It seems that to design an education action, the use of theoretical models that include not only the provision of information to change attitude and behavior, but also social and environmental variables, provides better program outcomes (Seaman & Eves, 2006). Further research should be developed to analyze the adequacy of different consumer behavior models regarding safe restaurant choice as a basis for the development of education programs.

It is recommended that future studies about the theme of the present survey be carried out with much larger consumer samples, since one of the limitations of the present study was the size of the sample, which did not allow for extrapolation of the results to the whole population.

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