

An Investigation into How far do Residents Adopt Measures to Reduce Microbial Hazards During food Handling

RAJESH JEEWON*, SEERAUJ NOUVISHIKA,
DAUHARRY SOODESH KUMAR and AHINSA JHEELAN-RAMCHANDUR

Department of Health Sciences, Faculty of Science, University of
Mauritius, Reduit, 80837, Mauritius.

Corresponding author Email: r.jeewon@uom.ac.mu

<http://dx.doi.org/10.12944/CRNFSJ.5.1.02>

(Received: March 10, 2017; Accepted: April 12, 2017)

ABSTRACT

Foodborne diseases have always been linked to numerous food manufacturing elements and home practices of purchasers and the latter does play a critical role in disease prevention. Consumers have the ultimate responsibility for handling and storing food safely and take adequate safety precautions when preparing and consuming food at home to avoid health related problems associated with microbial hazards. The objectives of this survey were to evaluate current knowledge of consumers pertaining to food hygiene and food safety concepts as well as to assess food handling practices that residents adopt to reduce microbial hazards in the domestic environment. A sample of 300 Mauritian residents were selected to participate in a questionnaire based survey. Questions in the questionnaire were based on hygienic practices with respect to food handling, food safety and personal hygiene. SPSS (Statistical Package for Social Sciences) was used to analyze the results and Microsoft excel was used to generate pie charts, and bar charts. The results obtained demonstrated that the level of knowledge pertaining to food safety and food hygiene and how to reduce microbial hazards were above average. Majority of the residents were knowledgeable about major aspects related to proper food handling behaviors but need more education pertaining to the use of thermometers to check for food temperature. The nature of the risk, personal and environmental factors (psychological, demographic and socio-economic factors, cultural and economic) were found to be the factors affecting food safety behaviors among consumers. Consumers can become more motivated to improve their behaviors if they are made aware of the impact of risky practices. Although, most consumers had basic knowledge pertaining to food safety, food hygiene and food handling practices, it is important to continually inform consumers about safe food handling practices through various channels.

Keywords: Consumers, Food Safety, Food Hygiene, Food handling practices, Foodborne diseases.

INTRODUCTION

Foods that are unsafe act as worldwide health dangers and are carriers of foodborne related diseases. The frequency of foodborne illnesses is increasing in developing nations and it has been reported that in year 2000, 2.1 million people die due to diarrheal sicknesses. Moreover, a study indicated that millions of people fall sick each year and thousands face death due to the consumption of contaminated foods and food related disease

can be a result of intentionally consuming raw and undercooked foods (e.g by adopting 'risky' eating habits) (Kaferstein, 2003). Food handling and food safety among residents are major concerns and food safety demands appropriate handling from manufacture through consumption. This will inevitably reduce foodborne diseases and consequently health care costs. Human health may be at risk due to microorganisms introduced through foods during harvesting, slaughtering and consecutive handling, preparing and even storing.

Additionally, food may be spoiled by bacterial action (and release of toxins) thus making it unsuitable for consumption or pose health hazards to humans. It has been demonstrated that handling practices can have also have an impact on bacterial growth, which are major contributors to foodborne diseases. The number of food poisoning cases in Mauritius is quite alarming. There has been 147 cases reported for food poisoning in year 2016 together with 35165 cases of gastro-enteritis (Health Statistics Report, 2016). Mauritius, despite being a small island, has experienced many serious outbreaks in connection with food poisoning in the past years. In 2016, the total number of cases of gastro-enteritis treated in public hospitals was 35,165 and adopting proper hygienic practices in food handling and increased consumer awareness on food related diseases could have undoubtedly curbed down these alarming cases.

Consumer food safety studies have been conducted in Europe, North America, Australia, and New Zealand. Information from these studies demonstrates that a significant extent of foodborne infections is ultimately linked to improper food preparation practices in consumer's home (Redmond and Griffith, 2003). Foodborne ailments can be prevented by educating the purchasers about the risk of improper food handling behaviors as a significant amount of food is prepared and handled in the household environment (Kaferstein, 1997).

Published surveys have indicated that majority of the participants wash their hands before dealing with crude meat or poultry (Altekruse *et al.*, 1996; Yang *et al.*, 1995; and Shiferaw *et al.*, 1997). Other studies (e.g- Badrie *et al.*, 2006 and FDA, 2006), also revealed that most of the respondents, expressed that it is important to clean chopping board after cutting crude meat and before dealing with other items that will be consumed uncooked. This indicates that respondents had to some extent good knowledge and adopt food handling practices to limit microbial contamination. However, it has also been demonstrated that consumers in many societies were unfamiliar with the ideal refrigeration temperature and many consumers did not make use of a thermometer while preparing food and gaps were also noticed in consumer education and behaviors linked with food safety at home. Despite

the fact that many respondents knew that food poisoning could originate by consuming meat and chicken not cooked to correct temperatures, only few constantly utilized a thermometer to check doneness for meat. Moreover, potentially dangerous practices were actually seen in household food preparation settings where respondents do not adhere to basic food safety rules during food preparation which can probably lead to cross-contamination. It was also reported that participants rarely or never wash their fresh vegetables while meat and fish products were kept above other foods in the fridge (Bruhn, 2002) thus demonstrating improper food handling practices which could increase the risk of microbial contamination.

With a specific end goal to receive good sanitation behaviors in the home environment, purchases need to be educated about safety programs on how to handle, store and prepare domestic food. With a population of approximately 1.3 million in Mauritius, limited research has been carried out directly on food safety knowledge, awareness and food handling behaviors of consumers. It is necessary to comprehend consumer point of view and food handling practices towards management of future disease outbreaks especially those related to microbial hazards during summer in Mauritius. Until now, there are no such special food safety actions/ education programs focusing on the vulnerable subgroups of the Mauritian population. Hence, this study was undertaken to:

- a. evaluate consumer's knowledge on concepts of food hygiene and food safety.
- b. assess measures that consumers adopt to reduce microbial hazards during food handling.
- c. investigate food handling practices of consumers in domestic environments.

MATERIALS AND METHODS

A sample of 300 Mauritian residents was selected from both rural and urban areas to participate in a questionnaire based survey. The study was carried out from August 2016 to January 2017. A validated questionnaire as previously used by Akabanda *et al.* (2016) was used but slightly modified to cater for local needs. Questions in the

questionnaire were based on hygienic practices in handling food, food safety and personal hygiene when dealing with food. Ethic clearance was given by the University of Mauritius and all the participants were given appropriate informed consent. SPSS was used to analyze the results and frequency tables were drawn. The data collected were figured using Pie and Bar charts which were drawn using Microsoft Excel 2013.

RESULTS

Among 300 residents, 56% were female and 44% were male. Most of the participants were between the age group of 31-50 years (Table 1). Together, they represented 41.7% of the overall participants. It is observed that 61.7% of the participants have studied till the secondary level of education followed by 33.3% who have undertaken tertiary level. Furthermore, it can also be observed is that 5.0% of the residents have only completed their primary education.

In the present study, it was noted that 15% of the residents had full technical knowledge on food safety, 30.3% were aware, 47.7% answered neutral and 7% did not have food safety knowledge. Figure 2 shows that 79.3% of the residents claimed that food hygiene is very important whereas 2.8% thinks that it is less important, 6.1% voted for neutral, 10.6% said that food hygiene is important and 1.2% voted for not important.

With respects to symptoms, 60.2% of the residents suffered from symptoms such as vomiting,

diarrhea, fever, abdominal pain after consuming a food product after 24 to 48 hours whereas 39.8% did not suffer from these symptoms. Table 2 summarises the knowledge of consumers on the concept of food hygiene and food safety.

1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly Agree.

Table 3 summarises responses in connection with precautions and food handling practices undertaken by the respondents to reduce microbial hazards whereas Table 4 depicts food handling practices residents do often when chopping, preparing and eating food items in a domestic environment.

DISCUSSION

Purchasers assume a significant role in avoiding and controlling food related illnesses as all hygiene measures required in producing, storing and distributing food may be disregarded by inadequate food handling behaviors (Angelillo *et al.*, 2001). The majority (74.3%) of the respondents in this study were aware of how food poisoning is caused, hygienic behaviors and risk of not storing food and vegetables properly. On average, 54% of the residents were not aware on the correct temperature of freezer and refrigerator.

In the present study, it was noted that 15% of the residents had full technical knowledge on food safety, 30.3% were aware, 47.7% answered neutral and 7% did not have food safety knowledge. In New Zealand, the absence of buyers education for food security and poor behaviors in the home have been recognized as conceivable contributing variables to the huge amount of campylobacteriosis (Al-Sakkaf, 2012). Studies also demonstrated that consumers with a lower level of education have less knowledge on food safety and poor food handling behaviors. The findings obtained in this study showed that 19.9% of the residents claimed to have full knowledge on food hygiene and a very small percentage (2.3%) did not have knowledge on food hygiene. Moreover, the results gathered from this study demonstrated that the importance of food hygiene was rated as highly important on a scale of 1 to 4 by 79.3% (Figure 1). In 2016, there were 147 cases reported for food poisoning whereas in 2015 only 82 was detected and this demonstrates that the number of food

Table 1: Demographic profile of respondents

Gender	Frequency	Percentage (%)
Male	132	44
Female	168	56
Age		
18-30	100	33.3
31-50	125	41.7
Above 51	75	25.0
Level of Education		
Primary	15	5.0
Secondary	185	61.7
Tertiary	100	33.3

poisoning cases has surprisingly increased. This demonstrates that even if the Mauritian consumers are well educated and sensitized through awareness campaigns and trained on proper food handling practices through the media, there is still room for improvements and other avenues remain to be explored to curb down this increasing trend.

Results of this study have also revealed that most of the respondents possessed the necessary knowledge in food safety and behaved responsibly. 56.4% of the respondents agree that contaminated food normally have some variation in color, odor or taste. Some of the results indicate that residents were barely acquainted with time and temperature and their impact on food safety. An average of 65 % of the residents were uncertain on the statements

“the correct temperature for storing easily-spoiled foods is lower than 5°C and ‘hot, ready-to-eat food’ must be kept at 63°C. A survey likewise done by Bas *et al.* (2006), demonstrated that information on basic temperatures for prepared to-eat foods, satisfactory temperature ranges for fridge and cross-contamination by the participants were needed. In another study it has been reported that one of the main contributing factors to microbial contamination is food that has already been cooked supposed to be served hot, but prepared beforehand and kept for several hours, and such foods may shelter destructive pathogenic microorganisms (Eustasie, 1995). However, the participants herein had sufficient knowledge (62.3%) that keeping food at refrigerated temperature will delay bacterial growth and proliferation, thus avoid food decomposition. In

Table 2: Showing the knowledge of consumers on the concept of food hygiene and food safety.

Statements	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Food hygiene can prevent foodborne illnesses	-	1	30.2	39.8	29
Well cooked food is free from microorganisms	-	2	24.3	53	20.7
Uncovered food is not free from microorganisms	-	1	15	27	57
Washing hands before handling food reduces the risk of food contamination	-	2	11.6	23.1	63.3
Contaminated food always have some change in color, odor or taste	-	1.2	14.3	56.4	28.1
Reheating cooked foods can contribute to food contamination	-	3	24	55	18
The correct temperature for storing perishable foods is below 5°C	1	-	59.7	32.3	7
Keeping food at refrigerator temperature will slow down the microbial growth and multiplication, thus prevent food spoilage	-	-	10.0	62.3	27.7
Bacteria need water, food, warm temperatures to grow and multiply	-	-	27.3	69.7	3
Hot, ready-to-eat food should be kept at a temperature of 63°C	-	2.5	72.1	20.4	5
Food poisoning is caused by microorganisms	-	-	59.1	22.9	18.0
Some toxins produced by microorganisms are the cause of food poisoning	-	-	24.3	56.7	19
Eating unwashed vegetables is a high risk of food poisoning	-	-	16.8	10.8	72.4

contrast, 59.1% were uncertain that food poisoning is caused by microorganisms while 72.4% strongly agreed that eating unwashed vegetables poses a high risk.

Food safety is major concern for all categories of people. Nevertheless, from this current study, 60.2% of the residents suffered from symptoms such as vomiting, diarrhea, fever, abdominal pain after consuming a food product after 24 to 48 hours. Food that is unsafe has been concerns to human health since a long time and numerous food safety issues experienced are not new (Gaungoo and Jeewon, 2013). The results for practices of the residents regarding how to reduce microbial hazards were above average. Some of the residents were knowledgeable about some of the safe food handling behaviors but they lacked knowledge. Essentially, it has been revealed that the consumers' education on food safety is insufficient and needed changes in nearly all situations (Redmond and Griffith, 2003).

Karabudak *et al.* (2008) reported that hands must be washed with warm water and soap for not less than 20 seconds as hands has long been viewed as a critical vector for microbes and hand washing before food preparation causes food poisoning less likely to happen. The results of this study demonstrate that the majority of residents (94.3 %) wash their hands with soap and water

before preparing food whereas 5.7% do not .72.2% washed their hands with water and soap before eating their meal. Our results corroborate with the study done by Kusumaningrum, *et al.* (2002) which demonstrated that *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* species survive on hands and surfaces for hours or even days after initial contact with microorganisms. Jay *et al.* (1999) reported that the risk of cross contamination can increase if hands are not washed without cleanser temporary microflora on the skin is not eliminated. Moreover, insufficient cooking of meat and cross contamination because of poor washing of hands while handling food are major causes of numerous foodborne sicknesses (Clayton and Griffith, 2008; Mederios *et al.*, 2001 and Farahat *et al.*, 2014). In many surveys, most of interviewees revealed that hand washing is an important food safety behavior and that after dealing with crude meat, poultry, or fish, it is important to clean hands by washing them with soap and (warm) water (Knight *et al.* 2003; FDA, 2006; McCarthy *et al.* 2007; Odwin and Badrie, 2007; Jevšnik *et al.* 2008).

95.7% of the respondents claimed that they clean the kitchen counters and other surfaces after each use and 60.8 % said that it is important to check the temperature of refrigerators/freezers very often to decrease the risk of food contamination. Moreover, the majority (70.1%) ensured that cutting

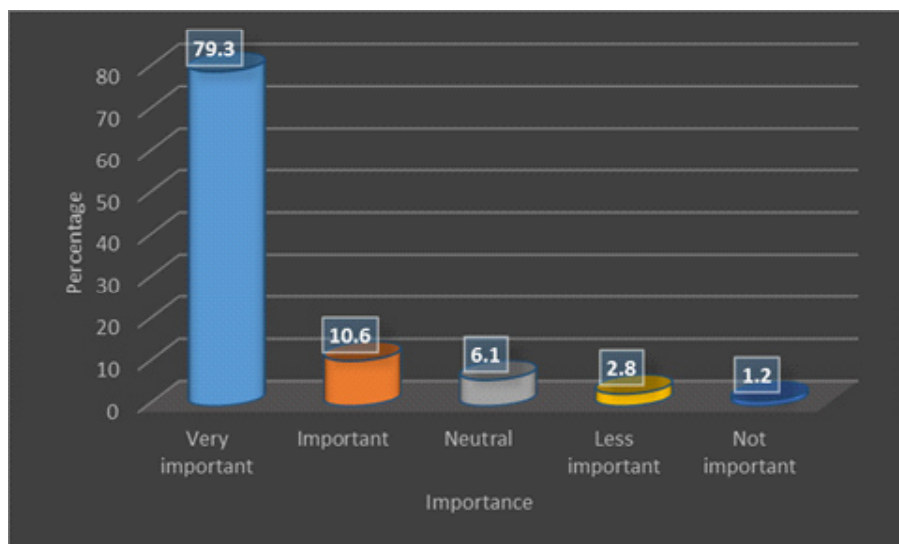


Fig. 1: Importance of food hygiene

Table 3: The percentage of the food handling practices that the respondents carry out to reduce microbial hazards.

Statements	Yes (%)	No (%)	No Idea (%)
Do you wash your hands with soap and water before preparing food?	94.3	5.7	0
Do you wash your hands with soap and water before eating your meal?	72.2	27.8	0
Do you wash your hands properly before touching raw foods?	68.3	19.7	12
Do you wash your hands properly after touching raw foods?	87.6	7.4	5
Do you eat fresh vegetables and fruits without washing?	37	51.6	11.4
I always ensure purchasing food that is clean and in fresh condition	61.3	25	13.7
Do you keep all food in covered containers or capped when storing food in the refrigerator?	47.5	36.3	16.2
Do you eat cooked food left at room temperature for over 6 h without sufficient heating?	15	56.2	28.8
Do you use food after the expiration date when the food has no change in its smell and/or taste?	5	69.8	25.2
I put the easy-to-spoil foods into the refrigerator as soon as I buy them	59.2	29.6	11.2
I check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination.	60.8	25.9	13.3
I clean the kitchen counters and other surfaces after each use	95.7	1.1	3.2
People with infected cuts, symptoms of common cold should not handle food?	88.6	2.1	9.3
Do you buy meat or poultry in packaging that is torn or leaking?	1.6	92.4	6
I put the meats and dairy products in the refrigerator when not in use	92.1	2.3	5.6
I ensure that the cutting boards are neat and clean before each use.	70.1	7.2	22.7
After purchase I use a cooling bag to transport meat from the shop to my home	17.1	77.4	5.5
I purchase refrigerated or frozen items after selecting the non-perishable items	89.7	1.2	9.1
I buy fish that has a bad smell and is covered with flies	0	98.2	1.8
Do you return cooked meat to the plate that held it raw	13.4	69.4	17.2
Do you put chicken in a plastic bag to keep juices from leaking	67.3	24.6	8.1
Do you cook chicken properly, to kill harmful bacteria	62.3	20	17.7
There is no risk of food poisoning from eating leftover cooked food kept in the refrigerator for 2-3 days	15.4	23.4	61.2

boards are neat and clean before each use. It was also found that 69.4% of the residents said that they do not return cooked meat to the same plate that held it raw. These results differ from those done by Williamson (1992) where only a lower proportion of participants revealed cleaning chopping boards using soap and water between utilizing it to chop crude meat and raw produce. Also, the utilization of similar chopping boards for crude and cooked food of animal and vegetable origin without washing them properly might be one of the reasons of food

contamination. 69.4% of the residents said that they do not return cooked meat to the same plate that held it raw.

Only a small proportion (7.3 %) of residents makes use of a thermometer to confirm the doneness of meat and poultry product. In studies done before, it was found that numerous buyers revealed that thermometers are unhandy and hard to utilize, particularly with little pieces of meat (McCurdy *et al.*, 2005). A large number of people reveal disappointment with the need to recall the diverse temperature requirements for beef, poultry, and seafood (Abbot *et al.*, 2012). Moreover, endpoint temperatures are rarely given in recipes and cooking programs—suggesting color as a guide of meat doneness is three times more regular than temperature (McCurdy *et al.*, 2006). Examination with the eyes is dangerous—for example, 70% of the chicken chunks that residents considered as “done” by visual examination had not come to the required cooking temperature and contained active cells of *C. jejuni* (Bergsma *et al.*, 2007).

Furthermore, during the study carried out, most of the respondents (62.7 %) claimed that they minimize the amount of time of any food spent in the danger zone. Leaving food that have already been cooked for longer times in the kitchen comprise a risky habit since food poisoning bacteria can develop to produce huge amount and/or toxins adequate enough to cause food poisoning. Keeping leftover food for many hours at the room temperature with inadequate warming was found to be the highest contributing element in bacterial food poisoning outbreaks. It was also demonstrated that the level of education can have an impact while deciding how to save leftovers safely. Kwon *et al.* (2008) and Terpstra *et al.* (2005) reported that the elderly people needed more knowledge on how long to store food. Numerous food safety behaviors, as well as keeping leftovers appropriately have decreased from 2008-2010 in the US revealed Cody *et al.* (2012), so people should be more conscious and more awareness campaigns should be done targeting the elderly people. 73.3% of the residents claimed that they make use of glass or pyro ceramic cutting boards instead of wooden boards to prevent colonization of bacteria. Some studies have showed that participants were more likely to utilize cutting

Table 4: Food handling practices residents do often when chopping, preparing and eating food items in a domestic environment.

I take care that food is heated thoroughly	79.6
Use a food thermometer to check the doneness of meat and poultry items.	7.3
When I start preparing other ingredients after preparing raw meat I use different cutlery, or wash my current set.	69.5
I ensure that different kinds of foods, such as meat, vegetables, and drinks, do not touch each other while stored.	75.9
I take care that meat packages do not touch clean working surfaces or cutlery.	59.1
I minimize the amount of time of any food spent in the danger zone.	62.7
I use glass or pyro ceramic cutting boards instead of wooden boards to prevent colonization of bacteria.	73.3
I defrost food safely by tightly wrapping meat, poultry or fish so that the juices do not drip on other food while defrosting in the refrigerator	79.2
I treat my groceries with care, in order to make sure that raw meat remains cool during transportation from the shop to my house.	54.2
Use raw eggs in salads and desserts	33.7

boards made of wood, thus adding up to the potential risk of cross-contamination. It is known that food must not be defrosted or kept on the work surface, as food pathogens multiply rapidly in the middle of the temperature danger zone (21–52°C) than at any other point (Badrie *et al.*, 2006). Most of the respondents in this study (79.2%) defrost food safely by tightly wrapping meat, poultry or fish so that the juices do not drip on other food while defrosting in the refrigerator.

CONCLUSION AND RECOMMENDATIONS

The opinions of participants were strongly taken into account to get a clear picture of their food handling practices and knowledge to avoid food related diseases. This survey underlines that residents had basic knowledge on food safety were aware of food safety and hygiene but some of them had poor food handling practices.

To sum up, it is important to know where errors are being made by the consumers while handling food. Moreover, more food safety education programs should be developed for the consumers so

that they can practice food safety effectively at home and these programs should also focus on safe food handling from buying through consumption.

The following recommendations can be implemented for good food safety behavior:

- Increase food safety awareness by doing campaigns and educate consumers about proper food handling by focusing more on the specific improper food handling behaviors identified in this study such as motivate the participants to make use of thermometers.
- Provide scientific knowledge on how microorganisms grow and cause food borne diseases and their link to improper behaviors.
- Media can help in assisting food safety education and health programs so as to enhance food hygiene at the domestic level as many consumers can be reached.

ACKNOWLEDGEMENTS

The University of Mauritius is thanked for appropriate research support. Participants in this survey are acknowledged as well.

REFERENCES

1. Käferstein FK. Actions to Reverse the Upward Curve of Food-Borne Illness. *Food Control*; **14**:101-9: (2003).
2. Health Statistic Report. Ministry Of Health and Quality Of Life Mauritius: Health Statistic Unit (2016).
3. Redmond, E.C. And Griffith, C.J. Consumer Food Handling In The Home: A Review Of Food Safety Studies. *Journal of Food Protection*; **66**(1): 130-161: (2003).
4. Käferstein, F.K. Food Safety: A Commonly Underestimated Public Health Issue. *World Health Statistics Q.* **50**: 3-4: (1997).
5. Altekruze SF, Street DA, Fein SB, Levy AS. Consumer Knowledge of Food-Borne Microbial Hazards and Food-Handling Practices. *J Food Prot*; **59**:287-94: (1996).
6. Yang S, Left MG, Mctague D, Horvath KA, Jackson-Thompson J, Murayi T. Multistate Surveillance For Food-Handling, Preparation, And Consumption Behaviors Associated With Food Borne Diseases: 1995 And 1996. *MMWR Morb Mortal Wkly Rep*; **47**: S33-57: (1998).
7. Marsha S and Badrie N. Household Consumer Food Safety Study in Trinidad, West Indies. *Internet Journal of Food Safety*; **V.3**, 8-14. (2004).
8. U.S. Food and Drug Administration. FDA/FSIS *Food Safety Survey Topline Frequency Report*. Retrieved From [Http://www.fda.gov/Food/ScienceResearch/](http://www.fda.gov/Food/ScienceResearch/). (2006).
9. Bruhn C, Schutz H. Consumer Food Safety Knowledge and Practices. Available At: [Http://Ucanr.edu/Datastorefiles/234-2474.Pdf](http://Ucanr.edu/Datastorefiles/234-2474.Pdf). (1998).
10. Angelillo I.F, Foresta M.R, Scozzafava, C, Pavia M. Consumers and Foodborne Diseases Knowledge, Attitudes and Reported Behavior in One Region of Italy. *International*

- Journal of Food Microbiology*, 64: 161-6: (2001).
11. Al-Sakkaf A. Domestic Food Preparation Practices: A Review Of The Reasons For Poor Home Hygiene Practices. Fig. 1: *Health Promotion International*; **30**(3): Pp.427-437: (2013).
 12. Ba^o M, Safak Ersun A, Kivanç G. The Evaluation of Food Hygiene Knowledge, Attitudes, and Practices of Food Handlers' In Food Businesses in Turkey. *Food Control*; **17**(4): Pp.317-322: (2006).
 13. Eustasie GD. Food Poisoning: A Constant Danger. Diploma. University Of Mauritius: (1995).
 14. Gaungoo Y, Jeewon R. Effectiveness of Training among Food Handlers: A Review on The Mauritian Framework. *Curr Res Nutr Food Sci* ; **1**(1):01-09 Doi : [Http://Dx.Doi.Org/10.12944/Crnfsj.1.1.01](http://dx.doi.org/10.12944/Crnfsj.1.1.01): (2013).
 15. Codex Alimentarius Commission. *Final Reportfao/WHO Regional Conference on Food Safety For Africa*. [Online] Fao. Org. Available At: [Http://Www.Fao.Org/Docrep/Meeting/010/A0215e/A0215e26.Htm](http://www.fao.org/Docrep/Meeting/010/A0215e/A0215e26.htm): (2003).
 16. Daniels, R. Home Food Safety. *Journal of Food Technology* **52**; 54-56: (1998).
 17. Karabudak E, Bas M, Kiziltan G. Food Safety in the Home Consumption of Meat in Turkey. *Elsevier Journal Food Control*; **19**: 320-7: (2008).
 18. Kusumaningrum Hd, Van Putten Mm, Rombouts Fm, Beumer Rr. Effects Of Antibacterial Dishwashing Liquid On Foodborne Pathogens And Competitive Microorganisms In Kitchen Sponges. *J. Food Protection*; **65**: 61–65: (2002).
 19. Jay L.S, Comar D, Govenlock L.D. A National Australian Food Safety Telephone Survey. *Journal of Food Protection*; **66** (1), 130-161: (1999).
 20. Knight P. G, Jackson J. C, Bain B, Eldemire-Shearer D. Household Food Safety Awareness Of Selected Urban Consumers In Jamaica. *International Journal of Food Sciences and Nutrition*; **54**(4): 309–320. [Http://Dx.Doi.Org/10.1080/09637480120092107](http://dx.doi.org/10.1080/09637480120092107): (2003).
 21. Mccarthy M., Brennan M, Kelly A. L, Ritson C, De Boer M., & Thompson N. Who Is At Risk And What Do They Know? Segmenting A Population On Their Food Safety Knowledge. *Food Quality and Preference*, **18**(2): 205-217: [Http://Dx.Doi.Org/10.1016/J.Foodqual.2005.10.002](http://dx.doi.org/10.1016/J.Foodqual.2005.10.002): (2007).
 22. Odwin R, Badrie N. Consumers' Perceptions and Awareness of Food Safety Practices in Barbados and Trinidad, West Indies – A Pilot Study. *International Journal of Consumer Studies*; **32**, 394-398: [Http://Dx.Doi.Org/10.1111/J.1470-6431.2008.00675.X](http://dx.doi.org/10.1111/J.1470-6431.2008.00675.X): (2008).
 23. Jevšnik M, Hlebec V, & Raspor P. Consumers' Awareness of Food Safety from Shopping To Eating. *Food Control*; **19**: 737-745: [Http://Dx.Doi.Org/10.1016/J.Foodcont.2007.07.017](http://dx.doi.org/10.1016/J.Foodcont.2007.07.017): (2008).
 24. Mccurdy S, Takeuchi M, Edwards Z, Edlefsen M, Kang D, Mayes V, Hillers V. Food Safety Education Initiative To Increase Consumer Use Of Food Thermometers In The United States. *Br. Food J*; **108**: 775–794: (2006).
 25. Abbot J, Policastro P, Bruhn C, Schaffner D, Byrd-Bredbenner C. Development And Evaluation Of A University Campus-Based Food Safety Media Campaign For Young Adults. *J. Food Prot* ; **75**: 1117–1124: (2012).
 26. Bergsma N, Fischer A, Van Asselt E, Zwietering M, De Jong A. Consumer Food Preparation And Its Implications For Survival Of *Campylobacter Jejuni* On Chicken. *Br. Food J*; **109**: 548–561: (2007).
 27. Kwon J, Wilson A.N.S, Bednar C, Kennon L. Food Safety Knowledge and Behaviors of Women, Infant, and Children (Wic) Program Participants in the United States. *J. Food Protect*; **71**:1651–1658. [Pubmed]: (2008).
 28. Terpstra M.J, Steenbekkers L.P.A, De Maertelaere N.C.M, Nijhuis S. Food Storage and Disposal: Consumer Practices and Knowledge. *Br. Food J*; **107**:526–533. Doi: [10.1108/00070700510606918](https://doi.org/10.1108/00070700510606918): (2005).
 29. Cody M.M, Gravani R, Smith Edge M, Dooher C, White C. International Food Information Council Foundation Food And Health Survey, 2006–2010, Food Safety: A Web Enabled Survey. *Food Protect. Trends*; **32**:309–326: (2012).