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RESEARCH ARTICLE

HYGIENIC PRACTICES IN SECONDARY SCHOOL CANTEENS OF MAURITIUS

***Dayawatee Goburdhun, Arvind Ruggoo, Hudaa Neetoo and Mahima Beeharry**

Faculty of Agriculture, University of Mauritius, Réduit, Mauritius

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ABSTRACT

This study was carried out to shed light on food safety knowledge and practices of secondary school canteen workers and the level of hygiene prevailing in canteens of secondary schools. A survey questionnaire was administered face-to-face to 45 canteen workers to assess their food safety knowledge and practices with regards to food hygiene. A scoring system was used to determine the knowledge score where each good answer was allocated one mark and incorrect answer or 'do not know' was given a score of zero. A checklist was used to benchmark the level of compliance of these 45 school canteens to the requirements of the Mauritian Food Regulations 1999. Data was analyzed using SPSS Version 16.0. The overall mean score for food safety knowledge was 70.2 % (SD= 12.0%) ranging from 40% to 92 %. The overall mean compliance of the school canteens to the MFR 1999 was 69.7% (SD=13.9%) ranging from 32% to 94%. This study shows that compliance to the local food regulation should be enhanced in school canteens. Schools should provide adequate facilities, infrastructure and the appropriate environment conducive to safe food preparation and consumption.

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INTRODUCTION

School children are one of the most susceptible population group to foodborne diseases (FBD) which are more concentrated in schools and institutions rather than in the general community (Meftahuddin, 2002). Foodborne disease outbreaks have occurred in schools (62%) and academic institutions (17%) and a much smaller proportion (8%) in community gatherings (Soon, Singh, & Baines, 2011). Consuming food at school canteens has become more common among school children and adolescents (Esther, 2012). The American Meat Institute (2001) conducted a survey of 1,000 adults in the U.S and concluded that lifestyle changes affect food behaviour since women in the workforce have limited commitment to food preparation. Packed school lunch from home is less and less practised; consequently students have an increasing propensity to purchase foods from outside vendors including school canteens (Forsythe, 2010). In 2006, more than 1700 children were infected with Norovirus through school meal in South Korea (Forsythe, 2010). Many factors such as improper food handling practices, poor infrastructure and environmental facilities, personal hygiene of food handlers, personal hygiene of food handlers contribute to foodborne outbreaks. Lack of management and equipment required to safely prepare school lunches (News desk, 2012), inappropriate infrastructure for food processing (Kasturwar and Shafee, 2010), food handlers (Grieg *et al*., 2007) especially food handlers' improper food preparation practices and poor knowledge (Friedman *et al.,* 2004) have been identified as the major cause of foodborne diseases. Food handlers are also the main sources for the transfer of microorganisms to food from their skin, nose, and bowel and also from contaminated food to uncontaminated one or from raw to cooked foods (Takalkar and Kumavat, 2011). These safety concerns are associated with FBD and can be addressed by appropriate knowledge on safe food handling which can influence positively the intentions and practices of the food handler (Mead, 2005). Training is intended to enhance knowledge, skills and attitude (Sprenger, 2009); it promotes confidence, increases team spirits, reduces supervision and therefore increases the effectiveness of performance of food handler (Park *et al.,* 2010) and improves food handlers' practices in food handling (Cuprasaitrut *et al*., 2011). Mauritius, officially the Republic of Mauritius, is a newly industrialised multi-ethnic country situated in the South-West Indian Ocean with a population size of around 1.3 million. Pre-primary, primary, secondary and tertiary education is free and the literacy rate is 88.8% (Index Mundi, 2015). The rapid socio-economic development of the country led to the establishment of school canteens to cater for the needs of the

****Corresponding author: Dayawatee Goburdhun,***
Faculty of Agriculture, University of Mauritius, Réduit, Mauritius.

students attending the secondary schools (Subratty *et al.,* 2003). Though food poisoning is not a major issue in Mauritius, in the previous years, several food poisoning cases among school children have been reported in the local press (L'Express, 2003; Le Défi, 2010; L' Express, 2013; L' Express, 2014). Limited studies have been carried out in Mauritius to assess the hygienic conditions prevailing in school canteens (Soodursun, 2002, Bholah, 2011). Consequently the objectives of this study were to (i) evaluate the food safety knowledge and practices of secondary school canteen workers and (ii) assess the level of food hygiene prevailing in secondary school canteens.

MATERIALS AND METHODS

Sampling

There were 176 secondary schools in Mauritius as at 2013. 68 were state secondary colleges and 98 were private ones. A convenience sample of 41 schools both from private (8) and public (33) institutions were selected for the study. Care was taken that the list included girls' schools, boys' schools and mixed schools proportionately according to all educational zones across the island. In all, 45 school canteens participated in this study as 4 out of the 41 schools had two canteens operating in their premises.

Evaluation of the food safety knowledge and practices of canteen workers

A questionnaire was designed to characterize the food handlers and to assess their food safety knowledge and practices. It comprised of four sections: Profile and characteristics of business, types and sources of food items, storage practices, food safety knowledge questions. The questionnaire after pretesting was finalised and administered through a face-to-face interview to the 45 school canteen workers. Data gathered was coded, entered, processed and analysed using SPSS V16.0 and MS EXCEL 2010.

For knowledge assessment, a scoring system was used where respondents were attributed a score of one for each *correct* answer and zero for each *wrong* answer and for *'don't know'*. The total scores were calculated and converted into percentages.

Assessment of the level of food hygiene in the school canteens

An on-site observation was carried out using a checklist based on Part V of the Mauritius Food Regulations [MFR, 1999] (Ministry of Health and Quality of Life (MOHQL), 1999). 42 out of the 45 school canteen operators agreed to participate in this exercise. A scoring system was applied to each criterion of the checklist. A rating of 1 and 0 was given to each criterion, which was fully compliant and not compliant respectively. The score of each canteen was computed as a percentage using Microsoft Excel 2010 by calculating the sum of scores of individual criterion of each category and the total percentage compliance.

RESULTS AND DISCUSSION

About 75% of the respondents were female. 50% and 40% of the canteen operators were aged between 30-44 years and 45-60 years respectively. 77% of the respondents had attended secondary schools. Tan *et al*. (2013) observed that most primary school canteen workers in Malaysia were well educated and the highest education level was a diploma (4%) followed by secondary schools (64%) while the remaining completed primary schools (32%). More than 70 different food items were on sale in the school canteens. Many food items were prepared on-site in the canteens to varying extent while some were outsourced or prepared at home in the domestic kitchen of the canteen owner. Besides water, the main beverages sold were fruit juice followed by tea/coffee. This is a result of the banning of sale of soft drinks on school premises by the Ministry of Health and Quality of Life in 2009 as a measure to contain overweight and obesity in children. The most common foods sold were wheat-based products like bread stuffed with vegetables/sausages/meat followed by Roti (wheat-based pancake stuffed with curry) and Panini. These food items are filling, convenient to eat during school break and they form part of the Mauritian culture and they are allowed on the list of foods to be sold in school canteens.

Table 1. Percentage of Food safety knowledge for each parameter

Knowledge Statements	% of respondents (n= 45)		
	Correct answer	Incorrect answer	Don't know
General food safety	98.5	0	1.5
Sources of Contamination	84.0	15.1	0.9
Personal hygiene	77.0	20.7	2.2
Safe and unsafe food	56.3	42.6	1.1
Storage of food	55.5	32.6	11.9
Food handling practices	55.1	20.0	24.9

Table 2. % Compliance to Criteria Specified in MFR 1999

Criteria	% compliance per category
Control of operations	100
Food handlers' Certificate	100
Walls	91
Re-usable containers for inedible materials and waste	91
Fridge/ refrigerator/ chilled rooms	90
Equipment and utensils	90
Wrapping of food	83
Building, design and facilities	79
Door	76
Floors	75
Waste management	74
Crockery and utensil	74
Use of drinking straws	74
Personal hygiene	73
Pest control	67
Cleaning and disinfection	65
Storage of food	63
Ceilings	61
Cleaning agents and disinfectant	61
Temperature control	57
Scullery	49
Preparation tables	47
Adequate hand-washing facilities	46
Windows	42

The most popular hot meals were fried rice and fried noodles which were served in disposable containers. However, fried rice and noodles are not permitted for sale in school canteens. This can be explained by children's demand of such foods which are not only tasty but easy to serve and be consumed in disposable containers. A limited amount of fruits was on sale. Indeed this should have been a mandatory requirement for all canteens to encourage consumption of fruits.

Food storage practices

Refrigeration was the most common storage method used for most products (meat, fruits and vegetables) and leftovers. This indicates that most of the respondents were knowledgeable about the storage temperatures at which the proliferation of microorganisms is hindered as the danger zone temperatures are from 5^0 C to 63^0 C (Ridgwell, 1997). Leftovers were stored mainly in the refrigerator (42%) but some also stored them on the countertop. In some cases, the canteen workers would consume the leftovers during the day itself. Others reported bringing them home for domestic use (24%). Leftovers stored for more than 2-3 hours may not be safe for consumption since pathogens which survived a first cooking may grow at ambient temperature and therefore adequate reheating at 165^oF is essential to destroy these pathogens prior to consumption (Washington State University, 2009).

Assessment of food safety knowledge

The average percentage of *correct, incorrect or don't know* answers for all the 25 food safety knowledge questions averaged over the 45 school canteen workers were 69 %, 24 % and 7 % respectively. The overall food safety knowledge score was 70.2 % (SD= 12.0%) ranging from 40% to 92%. Afolaranmi *et al.* (2015) reported that food vendors in primary schools in Nigeria had good level of knowledge on food safety and hygiene with a mean score of 55%. In Malaysia, restaurant workers had good knowledge of food safety with a mean score of 90.3 ± 7.79 (Rosani *et al.*, 2014). Table 1.0 summarises the knowledge score for different aspects of food safety.

General food safety

99% of the respondents had correct knowledge on general food safety statements. Over 98% respondents knew that food poisoning could be caused by microbes and chemicals and also correctly identified unhygienic practices as a source of food contamination. All the respondents were aware that food poisoning could cause severe diseases that end in hospitalisation and sometimes death. Food handlers are required to follow a six hour course in food safety following which they undergo a medical examination to obtain a Food Handler's Certificate. One of the modules is on food microbiology and this may explain the high level of knowledge in this topic. Besides, most of the incidents of FBD in Mauritius are associated with microbes, thus food handlers were knowledgeable on this issue.

Sources of contamination

Knowledge on sources of food contamination was good overall as 84 % of the respondents gave correct answers for this section (Table 1). Over 80% of the respondents also knew that pathogenic microorganisms could not be seen with the naked eyes. All participants knew that open undressed wounds could serve to transfer pathogenic microbes. Respondents (82%) were aware of the risk of cross-contamination when using the same cutting boards and knives for raw and ready-to-eat foods. Almost all had correct knowledge regarding wiping cloth. Indeed wiping cloths can easily spread microorganisms to food if the same wiping cloth is used to clean preparation area and cooked food storage area, it has therefore been recommended to disinfect wiping cloth before use and to keep it is a disinfecting solution when not in use (FDA, 2009). However, 40% were not aware that cockroaches and other insects were mechanical vectors of pathogenic microorganisms.

Personal hygiene

77 % of the respondents correctly answered the questions relating to personal hygiene. Nee and Sani (2011) reported a lower mean score of 57.8% on food safety and hygiene among food handlers of residential colleges and canteens in a Malaysian University. Most (90%) respondents knew that aprons should be worn in the food preparation area only. 82% was aware that wearing jewelleries and nail polish is unhygienic during food preparation. However, only 60% respondents knew the importance of wearing both aprons and hairnets during food preparation in the canteen. Tan *et al.* (2013) reported a much lower knowledge score of 10.7% on the importance of hair restraints among the food handlers. During the training for Food Handler's Certificate, food handlers follow a module on personal hygiene thus food handlers have been imparted with the relevant knowledge.

Safe and unsafe food

56% correctly answered questions related to safe and unsafe foods. Most respondents (92%) knew that products in swollen cans should not be used nor consumed as they often indicate presence of gases such as carbon dioxide or hydrogen which is produced by microorganisms which indicates that the food is spoilt (Sprenger, 2009). 96% of respondents acknowledged that unwashed fruits could cause food poisoning and FDA (2015a) recommends that raw fruits and vegetables should be rinsed before consumption or preparation. Nearly 90% of the respondents incorrectly assumed that '*spoilt food always causes food poisoning'* and that '*unsafe food always smells or taste bad'* which is incorrect. Spoilage of food becomes evident when the population of organisms rises to 10^8 per cm^2 (Sprenger, 2009). In this case, the canteen operator may sell unsafe food to students which can lead to major liabilities. 62% of respondents knew that foods stored in the refrigerator are not always safe. For instance, the shelf life of a food product depends on the storage temperature and the type of spoilage microorganisms present since microorganisms survive and grow in specific conditions (Sprenger, 2009). Only 62.2% of the respondents knew that cooked meat should be stored in the fridge and reheated prior to serving. At low storage temperatures, bacterial spores cannot grow and therefore it maintains the safety of the food (FDA, 2015b). 38 % did not have the correct knowledge and may be storing the cooked meat at room temperature and consumption of such foods may lead to food poisoning.

Storage of food

About 55% of respondents correctly answered questions regarding storage of foods.With respect to storage of raw and ready-to-eat foods in the refrigerator, half of the respondents knew that *'vegetables should be placed on a higher shelf in the refrigerator'* to avoid cross-contamination with raw animal-derived products. Almost 2 out of 5 respondents incorrectly assumed that harmful bacteria are killed during refrigeration. Bacteria are known to survive at low temperatures, especially psychrotrophic food spoilage bacteria (FDA, 2015b). Around 42% of the respondents had incorrect knowledge on reheating of foods. Foods reheated for immediate consumption should achieve a temperature of 82^{o}C (Sprenger, 2009). At 82^{o}C, all vegetative pathogens are destroyed and therefore make the food safe for consumption. While reheating may destroy pathogenic bacteria in foods, toxins produced by *Staphylococcus aureus* and *Bacillus cereus* in foods are heat-stable and will not be destroyed (Washington State University, 2009).

Food handling practices

About 55% of respondents answered correct answers on this section. Over 90% of respondents were aware that door handles and wiping cloths could serve as vehicles of pathogens. 62% of canteen workers knew that healthy food handlers may be a source of foodborne pathogens. Only 62% of the respondents had the correct knowledge on the correct method of thawing frozen meat; out of which several food handlers still adopted wrong thawing practices. Improper thawing of frozen food provides an opportunity for food poisoning bacteria to multiply to harmful levels and produce toxins (FEHP, 2009). Frozen foods should be thawed under running water (Hernandez, 1998; Brown, 2000) or kept under refrigeration for 24 hours at a temperature of 4.4^{0}C (USDA, 2013). Food handlers were less knowledgeable about temperature storage regimes for food, with almost 67% respondents being unaware of the correct temperature for holding hot foods. Holding is a critical control point, or a point at which maintaining proper temperatures can help ensure that a food is safe to eat (National Food Service Management Institute, 2009). Canteen workers must know about the proper temperature for holding foods or else they might subject foods to temperature abuse. Furthermore, schools are not presently equipped with hot holding equipment. This has to be looked into by relevant authorities. Nearly 70% of the respondents did not have correct/or had incorrect knowledge on recommended final core temperature of cooked chicken or turkey. Chicken based products are sold in canteens therefore this knowledge is very important. In Mauritius, chicken are usually cooked thoroughly at high temperatures and this core temperature may be achieved but it is not a common practice to record the core temperature thus this may explain the high level of '*do not know*' (66.7 %). Rosnani *et al.* (2014) also reported a lack adequate knowledge on safe temperature of cooked foods.

Assessment of level of food hygiene in the school canteens

The overall compliance of the school canteens to the Mauritan Food Regulation 1999 was good with a mean score of 69.7% (SD=13.9%) with the lowest score of 32% and highest score of 94%. 76% of the schools had a compliance score of 70 and above while only 2 schools achieved a score of 40% or less.

Compliance of school canteens with the MFR 1999

Full compliance was noted for control of operations and possession of a Food Handler's Certificate (Table 2). Similarly, Tan *et al.* (2013) reported full compliance for possession of a certificate of food hygiene training among the respondents. Although all food handlers had a Food Handlers' Certificate (FHC), this does not imply that the food handler has good knowledge in food safety. Gaungoo and Jeewon (2013) were critical about training provided by the MOHQL to the food handlers. They believed that current training being provided to the food handler was not adequate since it is given only once while education should be a continuous process. Continuous training and monitoring can indeed increase the food safety knowledge and practices of the food handlers (Park *et al*., 2010). Respondents also made correct use of re-usable containers. Equipment and utensils were also of appropriate materials and properly kept. Wrapping of food was done correctly with food grade material in the majority of cases.The canteen had an acceptable level of hygiene with some minor problems which may impact on the food safety and quality. Main areas of concern were Temperature control, Scullery, Preparation tables, hand-washing facilities and windows.

Building, design and Facilities

Mean compliance score for building, design and facilities was 79%. In many canteens, the infrastructure was in a bad state with visible cracks. Moreover, some canteens did not respect the unidirectional flow of materials. Moreover, the premises were not constructed in a way to facilitate cleaning and disinfection. Some canteens did not have adequate working spaces thereby increasing the chances for cross-contamination.

Floors, Ceiling and Walls

Some canteens did not have skid proof tiles and in some cases, there were visible crevices which can rendered cleaning and disinfection difficult. In this study, 75 % of the canteens fully met the requirements of the MFR (1999) regarding floors. Ceilings and walls should be constructed with materials which are non-toxic, durable, well fixed or applied and easy to maintain (Sprenger, 2009). The ceilings and walls of some canteens were not in good condition. Some ceilings were too high thus rendering it difficult to clean. This could result in accumulation of dirt, microorganisms and fungi. Walls contained a lot of crevices and were cracked. Wall surfaces in kitchens and other processing areas must be finished with materials such as ceramic tiling, vinyl sheeting or stainless steel (ANZFA, 2001). A non-conformity observed in most canteens was that the angle between walls and ceiling was not properly coved which is a requirement.

Personal hygiene

All the food handlers had a valid FHC and 73 % of the food handlers complied with the requirements for personal hygiene.

This is closely related with knowledge score for personal hygiene (77 %) implying a high degree of implementation. Many food handlers did not use hair nets and aprons and 40% of them did not have correct knowledge on use of aprons and hairnets while the MFR (1999) maintains the use of appropriate protective overall and hair coverings as compulsory. Some handlers were wearing jewelleries, watches and nail varnish even though 80% had the correct knowledge regarding use of the above items in a food premise. Jewelleries and watches may contaminate the food with dirt and bacteria while also increasing the risk of puncturing gloves. Moreover, a common non-compliance observed was that food handlers were wearing gloves while handling food but they did not change them at regular time intervals when required. Gloves are often seen as an additional cost to canteen owners; however it can be a source of contamination if not changed regularly. According to Curran (2010), gloves inspire a false sense of security and may lead to cross contamination; it has also been proved that microorganisms can pass through the tiniest hole of the gloves depending on their quality. All handlers were seen to handle money while engaging in the sale of unwrapped cooked food. This practice can transfer bacteria from the handler's hands to the cooked food (Lambrechts *et al.,* 2014) and is an offence according to MFR (1999).

Storage of food

Compliance to food storage requirements was 63 %. This can be explained by the knowledge score of food handlers on food storage (55 %), inadequate space and storage facilities as observed during the onsite inspection. The state of the fridge and refrigerator had a high compliance with the MFR with a mean score of 90%. The fridge/refrigerator was maintained in good hygienic conditions; they were free from foul smell, pest, insects and food residues.

Temperature control

A leading cause of foodborne illness is time and temperature abuse. In this study, compliance score for temperature requirements of MFR (1999) was 57%. This could be explained by inaccurate knowledge the canteen workers had on temperature of storage, cooking temperature, reheating of foods. Furthermore, there were inadequate facilities for temperature control in the school canteen premises.

Scullery

Compliance score for scullery was 49 % and many canteens visited did not have a scullery separated from the food preparation area. In some cases, food was being prepared just next to the wash basin and this could be a potential source of cross-contamination. All of them had access only to cold water for cleaning purposes. In the MFR (1999), it is recommended to clean utensils with hot water as soon as practicable after use to increase degreasing process.

Preparation table

The mean compliance score obtained for preparation canteen tables was 47%. Smooth surfaces are more easily cleaned and will not accumulate soilage and hiding places for microbial growth unlike a rough surface (Fraser and Pascall, 2010). The factors responsible for the poor score could be attributed to the fact that many canteens did not have dedicated working surfaces for raw and ready-to-eat foods. A common non-conformity for all canteens was that there was no separate sink to wash vegetables and meat which could lead to cross contamination of vegetables by meat borne pathogens such as *E. coli* O157:H7 and *Salmonella*. Since vegetables are usually consumed raw or minimally processed i.e. they lack a final heat-killing step, they could serve as vehicles of foodborne illnesses. Moreover, some tables had in built cupboards underneath: they hindered cleaning and could be a potential site for harbourage of pests.

Hand washing facilities

'Hand washing facilities' was one of the criteria with the lowest conformance (46%) to the MFR (1999), yet it is one of the cheapest and most efficient way to prevent the spread of infection. All canteens operated with a manual tap which can be a potential source of cross contamination as these surfaces have often been found contaminated with *E.coli*. Many canteens lacked nail brush; hand drying facilities, soap dispenser and paper towel dispenser. These basic requirements for adequate hand washing were not present in the school canteens surveyed which indicates that proper hand washing does not occur before start of operations. The canteen holders were found to be using cloth towels instead of hand dryers or paper towels.

Windows

Windows complied least (42%) to the MFR (1999). In most cases, there were no nets to prevent access to pests. In some schools, there were no proper window opening to allow proper ventilation and lighting. All food premises should have natural or mechanical ventilation and natural or artificial lighting as per the MFR 1999 and the Australian Standard 2004. Ventilation is important to provide a safe working environment and to also control the level of humidity which prevents the growth of bacteria. Sufficient lighting is also required so that employees can identify hazards and carry out tasks properly.

Conclusions and Recommendations

The overall food safety score was 70.2 % (SD= 12.0%). Poor knowledge was particularly noted in reheating of foods, thawing of frozen foods, holding of hot foods and core temperature of cooked chicken/ turkey. This can be accounted by the absence of facilities for holding of hot foods and lack of information on these aspects in the training programme offered to the food handlers. The Food Handlers' training programme therefore needs to be reviewed. Very poor knowledge was shown for the following statement *'unsafe foods will always smell/taste/look bad.'* (11.1%) and *'A spoilt food will always cause food poisoning'* (13.3%). The overall compliance of the school canteens to the Mauritius Food Regulation 1999 was 69.7% (SD=13.9%). Degree of compliance was less than 60% for the following criteria: 'Windows'; 'Adequate hand-washing facilities'; 'Preparation tables'; 'Scullery and

Temperature control'. Full compliance was noted for 'control of operations' and possession of a 'Food Handler Certificate' The results of the present study can provide valuable information for the design of appropriate monitoring and surveillance programs for official food microbiological control. The responsibility of provision of safe food in school premises lies with school management, canteen operators, parents, students and regulatory bodies. Schools should provide the adequate facilities, infrastructure and the appropriate environment conducive to safe food preparation and consumption. Canteen operators should be provided with refresher course in food safety and hygiene and they should implement good manufacturing, handling and catering practices. Educational sessions on the various aspects food safety issues should be organized for students and parents to improve their knowledge on safe food choices and food handling practices. Finally, programs for inspection of canteen facilities and regular microbiological testing of canteen foods should be reinforced in school canteens.

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