

# Assessment of Food Safety Knowledge of Food Handlers and the Level of Implementation of Good Manufacturing Practices at Restaurants in Kegalle District, Sri Lanka

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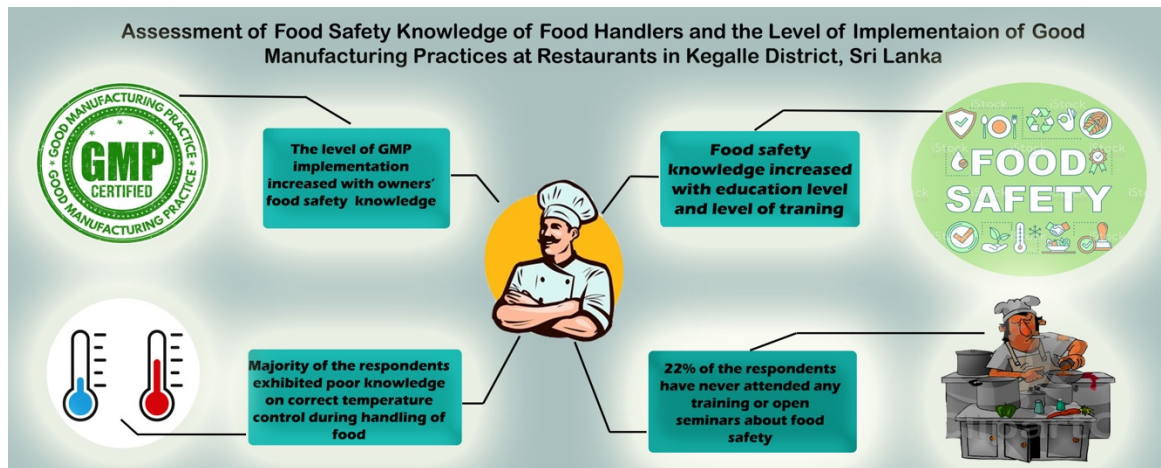
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## Abstract

The study aims to assess the food safety knowledge of restaurant owners/head chefs and to investigate the current level of implementation of Good Manufacturing Practices (GMP) in restaurants in Kegalle District, Sri Lanka. Data were collected from a convenient sample of 100 respondents (50 owners and 50 head chefs) of 50 restaurants in the Kegalle District using both researcher and self-administered questionnaires. The collected data were analyzed using Minitab (16/17) and the Microsoft Excel software packages. The General and in-depth food safety knowledge of the respondents were tested using a self-administered questionnaire which consisted of 24 questions. The GMP implementation was evaluated using a checklist consisting of 40 major Good Manufacturing Practices. The results indicate that the food safety knowledge of the respondents (restaurant owners and head chefs) increased with their education level and level of training. The mean in-depth knowledge score of the respondents was significantly different ( $p < 0.05$ ) from that of their mean general knowledge of food safety. Results indicate that 22% of the respondents have never attended any training sessions or open seminars related to food safety and showed poor knowledge, especially on aspects such as correct temperature control during handling food. The level of GMP implementation increased with restaurant owners' in-depth and total food safety knowledge. The food safety knowledge of head chefs did not seem to affect the level of GMP implementation at restaurants. Since the GMP implementation at restaurants is mostly affected by the restaurant owner's knowledge and skills, the authors recommend conducting training sessions or open seminars to upgrade their in-depth and total knowledge of food safety.



*Keywords: Food safety knowledge, good manufacturing practices, food handlers, Sri Lanka*

## 1. Introduction

Food safety concerns are increasingly particularly associated with restaurants with an increased number of foodborne disease outbreaks reported globally due to the ingestion of contaminated food or water (Majowicz et al., 2015; Ovca et al., 2014; WHO, 2020). Food safety is defined as “the assurance that food will not cause harm to the consumer when it is prepared, served, and eaten according to its intended use” (Codex Alimentarius, 2011). Globally, a large number of restaurants are engaged in serving meals for people every day, while a considerable number of food poisoning cases are being reported from such restaurants every year (Rebouças et al., 2016). Worldwide epidemiological studies report that the majority of foodborne diseases occur due to the incorrect handling of food (WHO, 2020). Food handlers comprise individuals who prepare, cater, and retail food products, as well as those who are involved in the restoration or maintenance of equipment present in food processing facilities (Al Suwaidi et al., 2015). Thus, following proper GMP by food handlers is significant in the prevention of foodborne diseases.

The origin of foodborne diseases can be chemical, biological, or microbiological (Rebouças et al., 2016). Among them, microbiological sources were found to cause the highest number of foodborne disease outbreaks. According to researchers’ point of view, one of the prominent factors causing these outbreaks is poor personal hygiene (Pichler et al., 2014). Proving evidence for the above statement, many studies have illustrated the availability of foodborne pathogens in the hands of food handlers, who act as carriers of foodborne diseases (Abdul-Mutalib et al., 2015; dos Santos Ferreira et al., 2013; Soares et al., 2012). In this regard, food handlers are recognized as one of the biggest contributors to the occurrence of foodborne diseases (Jackson, 2011; Jahan, 2012).

Adopting quality management approaches such as GMP by food handlers is one of the most promising approaches to minimizing food safety-related risks (De Oliveira et al., 2016). Adoption of GMP in food processing premises ensures safe and high-quality food preparation for controlling foodborne

diseases. Other benefits include a reduced number of consumer complaints; enhanced motivation, productivity, and psychological conditions of the employees; cleaner, safer and more satisfying working environment ( Da Cruz et al., 2006).

In Kegalle District, the demand among consumers for ready-to-eat cooked products has increased, consequently, the number of food preparation establishments. Sri Lankan Standards Institution offers several food safety certifications such as SLS ISO/TS 22002 part 1, SLS ISO/TS 22002 part 2, SLS ISO/TS 22000 and SLS 1266 to food manufacturing facilities, including the catering sector in Sri Lanka (Sri Lanka Standards Institution). However, these certifications are not mandatory for any food manufacturing or catering startup in Sri Lanka. Therefore, many small and medium-scale restaurants and catering firms do not pay much attention to complying with food safety and quality standards within their premises. Munasinghe et al. (2015) have also shown that catering establishments (especially medium and small-scale restaurants) in Sri Lanka often did not comply with the updated hygienic regulations in the country owing to the lack of resources required to bring them into practice. As a result, in Sri Lanka, the food regulations are being redrafted to ensure that all new food establishments obtain registration, which requires them to meet minimum standards before they start up (DeWaal and Robert, 2005). Therefore, small and medium-scale restaurants in Sri Lanka are confronted with a number of food safety and hygiene-related challenges. Those challenges include poor supervision, monitoring, and validation by individuals who are responsible for ensuring food safety within the country, poor implementation of GMP and regulations relevant to environmental and public health, and a lack of comprehensive training programs to ensure food safety targeting food handlers.

This study was specifically aimed to evaluate the level of food safety knowledge possessed by food handlers: restaurant owners/head chefs in restaurants in Kegalle District, Sri Lanka and to demonstrate the level of implementation of good manufacturing practices by them at food establishments.

## **2. Materials and Methods**

### *2.1. Study design and data collection*

The study was directed at selected restaurants, mostly owned by a single person or a few people in Kegalle District, Sri Lanka. Data were collected from 50 restaurant owners and 50 head chefs, representing a total of 100 respondents (through convenient sampling) using a self-administered questionnaire and a researcher-administered checklist. Respondents were given around 20 - 25 mins to provide answers to the questionnaire, which was designed to test the in-depth and general food safety knowledge of the food handlers. A researcher-administered checklist was completed to estimate the current level of GMP implementations in each restaurant. The researcher took around 1-2 hours to complete one checklist through proper observations in the restaurant.

### *2.2. Questionnaire and checklist design*

The questionnaire consisted of three main sections. Section one consisted of demographic details of the respondents like age, gender, educational background, years of experience in food handling, nature

of the job, job satisfaction, and whether they have participated in systematic education in food handling. Section two included 12 questions to test the respondents' general knowledge about food safety. It consisted of 3 questions from the main category, namely food microbiology, correct temperature control, personal hygiene, and cross-contamination. Similarly, GMP implementation was evaluated using a checklist that consisted of 40 major good manufacturing practices under 5 major themes; building and structure, cleanliness and maintenance, personal hygiene, food processing, and food serving. The checklist was prepared using SLS 956:2016 standard for Good Manufacturing Practices as the reference (Sri Lanka Standard 956: 2016). All observations that complied with the requirement were given one point, while all observations that did not comply with the requirement were given zero points.

### *2.3. Statistical analysis*

Data were analyzed by using Minitab (16/17) and the Microsoft Excel software packages. Both descriptive and inferential statistical approaches were used to give meaningful insights from the data collected. Descriptive statistics included frequencies, percentages, means, and standard deviation of variables. Two separate scores were calculated to assess in-depth knowledge and general knowledge of food safety among food handlers, based on a scoring system (1 mark for each correct response and 0 for an incorrect response). Then, two overall mean scores were developed for in-depth knowledge and general knowledge of the food safety of the food handlers based on individuals' marks. The total food safety knowledge score was considered as the summation of the mean in-depth and general knowledge scores of the respondents. A similar score pattern was used to assess the level of GMP implementation in restaurants using a checklist.

To analyze the compare the mean scores of food safety knowledge of the respondents (total, in-depth, and general) across different knowledge categories or GMP categories, one-way analysis of variance (ANOVA) and Tukey's pairwise comparison tests were used at a 5% significance level. The mean scores of in-depth and general food safety knowledge of the respondents were compared using the two-sample t-test. The correlations between the food safety knowledge of respondents and demographic data and GMP implementation were evaluated using Spearman and Pearson Correlation Coefficients, respectively, at a 5% significance level.

## **3. Results**

### *3.1. Demographic details of the food handlers*

Of the 100 respondents who took part in the survey study, the majority (60%) were males. When the respondents' ages were analyzed, 16% of them were under 20 years, 44% were between 21 – 30 years, 27% were between 31- 50 years, and 13% were over 50 years. In terms of working experience, 24% had less than 1 year of experience, 39% had 1-5 years of experience, and 37% had more than 5 years of experience. Regarding the nature of the job, 50% of respondents were employed permanently and 50% were employed on a contract basis. According to the data, 21%, 39%, and 30% of the respondents had completed their education up to General Certificate of Education Advanced Level (G.C.E A/L), General Certificate of Education Ordinary Level (G.C.E O/L), and diploma/ degree respectively. Only a small percentage (10%) of the respondents reported that they had not completed G.C.E. O/L. Data indicate that 22% of respondents haven't had any formal training in food handling. Finally, when the respondents' level

of job satisfaction was assessed, 5% reported that they disliked their current job, 30% reported a neutral feeling towards the job, and 65% reported that they enjoy doing their jobs.

3.2. Food safety knowledge among food handlers

Table 1 represents the test results of One-way ANOVA and the total mean scores obtained by the respondents (n = 100) for each of the knowledge categories tested (food microbiology, correct temperature control, personal hygiene, and cross contamination). Accordingly, the total food safety knowledge scores obtained by the restaurant owners and head chefs (n = 100) for the personal hygiene category ( $4.68 \pm 0.95$ ) and correct temperature control while cooking ( $2.93 \pm 1.06$ ) were significantly different.

Table 1: The mean scores obtained by the food handlers for each knowledge category.

Knowledge category	Total food safety knowledge (Mean ± SD)
Food Microbiology	$3.89 \pm 1.19^b$
Correct Temperature Control	$2.93 \pm 1.06^c$
Personal Hygiene	$4.68 \pm 0.95^a$
Cross Contamination	$4.10 \pm 1.28^b$

\*Different letters in the same column indicate a significant difference ( $p < 0.05$ ).

Table 2 summarizes the results obtained by conducting the two-sample t-test between the in-depth food safety knowledge of the food handlers. According to the results, the obtained p value (0.000) was less than  $\alpha = 0.05$ . This indicates that the mean scores of in-depth food safety knowledge ( $8.53 \pm 1.64$ ) and general food safety knowledge ( $6.47 \pm 1.74$ ) were significantly different among the respondents.

Table 2: Results of the two-sample t-test between general and in-depth food safety knowledge.

General knowledge (Mean ± SD)	In-depth knowledge (Mean ± SD)	Sig.	t	DF	Estimate for difference = $\mu$ (General knowledge) - $\mu$ (In-depth knowledge)
$6.47 \pm 1.74$	$8.53 \pm 1.64$	0.000	-8.60	197	-2.06

3.3. Correlations between food handlers' total food safety knowledge and demographic data

Table 3 shows the Spearman Correlation Coefficient between the food safety knowledge of food handlers and demographics.

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Table 3: Correlations between total food safety knowledge of food handlers vs demographics

		Age	Gender	Experience	Education	Training	Nature of job	Job satisfaction
Total	ho	.029	.190	-.003	.293**	.198**	-.037	.097
knowledge	Sig.	.775	.058	.973	.003	.049	.713	.339

\*\*Correlation is significant at the 0.01 level (2-tailed).

There were positive and significant correlations among total food safety knowledge of the food handlers (n= 100), their educational background, and the level of training they received. (Table 3). The food safety knowledge of the respondents increased with their level of education and training.

### 3.4. GMP implementation at restaurants

Compliance with GMP in restaurants was evaluated under 5 major categories. In the building and structure category, 16% of the restaurants had allowed a unidirectional flow of the product, 26 % had accommodated separate areas for storing raw materials and cooked food, and 26% contained separate changing areas for food handlers away from the food processing area. Under the cleanliness and maintenance category, only 4% of the restaurants followed standard procedures available for cleaning, and only 12 % had a proper pest management system. Considering the personal hygiene aspects, only 20% of the restaurants had staff who wore appropriate clothes while preparing food. Of all the restaurants, 16% had designated supervisors to monitor compliance with GMP within the premises. Taking the food processing category into consideration, 46% of the restaurants had separate refrigerators/freezers to store ready-to-eat food and fresh produce, and 22% used gloves when handling ready-to-eat foods.

The results of One-way ANOVA across different categories of GMP implementation and total food safety knowledge are depicted in Table 4.

Table 4: Implementation of GMP across different categories within restaurants

GMP categories	Total food safety knowledge (Mean ± SD)
Building and structure	3.94 ± 1.97 <sup>b</sup>
Cleanliness and maintenance	3.56 ± 1.73 <sup>b</sup>
Personal hygiene	3.88 ± 1.71 <sup>b</sup>
Food processing	4.28 ± 2.10 <sup>b</sup>
Food serving	5.56 ± 1.76 <sup>a</sup>

\*Different letters in the same column indicate a significant difference (p < 0.05).

The results of One-way ANOVA denoted significant differences (p < 0.05) between the GMP implementation categories F (4,245) = 8.73, p = 0.000. Tukey's pairwise comparisons showed a significant difference (p < 0.05) between the food serving category and the other four categories; building and structure, cleanliness and maintenance, personal hygiene, and food processing (Table 5). Best GMP

implementation was observed for food serving ( $5.56 \pm 1.76$ ), followed by food processing ( $4.28 \pm 2.10$ ), building and structure ( $3.94 \pm 1.97$ ), personal hygiene ( $3.88 \pm 1.71$ ), and cleanliness and maintenance ( $3.56 \pm 1.73$ ). (Table 4).

### 3.5. Correlation between food safety knowledge of food handlers and GMP implementation

Table 5, presents the results of the Pearson Correlation Coefficient between the food safety knowledge of food handlers and compliance with GMP in restaurants.

Table 5: Correlations between scores of food safety knowledge and compliance to GMP in restaurants

Pearson Correlation Coefficients ( $r_p$ )		In-	General	Total
		depth	knowledge	knowledge
For restaurant owners				
GMP	$r_p$	.342*	.252	.366**
	Sig.	.015	.078	.009
For head chefs				
GMP	$r_p$	.234	.426	.232
	Sig.	.103	.115	.115

\*\*Correlation is significant at the 0.01 level (2-tailed).

Moderately positive linear relationships were found between the in-depth and total food safety knowledge of restaurant owners ( $n = 50$ ) with the GMP implantations (Table 5). Accordingly, compliance to GMP increased with the increment of the in-depth and total food safety knowledge of restaurant owners, while the food safety knowledge of head chefs did not affect compliance to GMP in restaurants.

## 4. Discussion

This study demonstrates the food safety knowledge of the food handlers (restaurant owners/ head chefs) and compliance to GMP in the restaurants of Kegalle District, Sri Lanka. Fifty restaurant owners and fifty head chefs representing a hundred respondents from hundred restaurants took part in the present study. The majority (60%) of the respondents were males. Most of the respondents (76%) who participated in the study reported experience of more than one year in food handling. Of the respondents (78%) reported participating in at least one training session, such as open seminars, certificate courses, diplomas, or degrees, suggesting that the majority of food handlers in the Kegalle district have a good level of knowledge and training on safe food handling.

Training sessions are important to create positive food safety culture among food handlers. Those sessions have to be conducted periodically to ensure that a safe and quality food product is manufactured and offered to the hands of customers (Soares et al., 2012). Although almost all the respondents (78%)

reported having had some sort of training in food handling, the results of the current study showed that a noticeable proportion of them did not possess adequate knowledge about the correct temperature control during food processing. Recent studies have demonstrated that temperature control is one of the key practices to control the over-growth of foodborne pathogens and the most critical reasons for the proliferation of pathogens, and the permanence of the microbial hazard in the food product, if done inappropriately (Akabanda et al., 2017; Matthews et al., 2017; Rebouças et al., 2017).

With the understanding that the knowledge of the food handlers increased with the increment of their education level and level of training, the authors recommend the food handlers be offered further education and training regarding safe food handling. Many recent studies have shown the importance of providing proper education and training to upgrade food handlers' knowledge which eventually assures the safety of the food prepared food (Akabanda et al., 2017; Cavalli and Salay, 2007; Gruenfeldova et al., 2019; Moreb and Priyadarshini, 2017).

The compliance to GMP in the restaurants was not satisfactory with respect to standard procedures for building and structure, cleanliness and maintenance, personal hygiene, and food processing. Many restaurants showed poor and non-conforming layouts in the building and structure with no unidirectional flow of the product (84%) and the absence of separate areas for storing raw materials and cooked food (74%). Considering cleanliness and maintenance, a clear majority of restaurants did not seem to follow standard procedures for cleaning (96%) and lacked a proper pest management system (88%). Lapses in personal hygiene aspects, such as handlers not wearing a separate set of clothes while food preparation, was noted. Apart from that, the lack of a designated supervisor to monitor GMPs of lower-level workers was also worrying. When GMPs related to food processing are considered, inspection and storage of raw materials is a critical control point, and the present study depicted risky practice, as many food processing facilities lacked separate refrigerators/freezers to store ready-to-eat food and fresh produce. A study carried out in Ireland has shown that there is a greater risk of contamination of food in restaurants' kitchens via utensils and working surfaces like countertops (Bolton et al., 2008). A clear majority of the respondents were shown not to use the color-coding method to distinguish between knives and cutting boards used for different food products, which is a fundamental GMP. Apart from that, a clear majority did not use gloves when handling ready-to-eat foods. Handlers who serve foods using bare hands can enhance the chances of food contamination and introduce pathogens to foods if they have improperly washed their hands (Nurudeen et al., 2014).

According to the results of the present study, it is evident that compliance with GMP in the restaurants of the Kegalle District increased with the food safety knowledge of restaurant owners, while no such significant effects were imparted by the head chef. Lack of financing, lack of space for the physical structure of the building, and lack of skilled professionals in the establishments limited the opportunities for the restaurants to comply with GMPs.

## **5. Conclusions**

Overall, the food safety knowledge of food handlers in restaurants of Kegalle District, Sri Lanka, concerning the areas of food microbiology, personal hygiene, and preventing cross-contamination was



higher than their knowledge of correct temperature control to ensure microbial safety of food. The in-depth food safety knowledge score of the respondents was significantly different from that of their general knowledge of food safety. The food safety knowledge of the restaurant owners significantly influenced the GMP implementation within restaurants, while that of the head chef showed no such impact. Similarly, the food safety knowledge of the food handlers who received proper education and training was significantly higher than those who had no education and training backgrounds. In conclusion, the authors recommend the provision of periodical food safety education programs and training sessions to upgrade the food handlers' knowledge about food safety and GMP implementations within restaurants.

**Author contributions:** Piumi De. Abrew Abeysundara contributed to the conception and design, supervised the work, and revised the manuscript critically for important inclusions. Lahiru Chandoda Nawarathne, Piyumi Chathurangi Wanniarachchi, and Hashan Savinda Peiris contributed to the acquisition of data, analysis and interpretation of data, drafting of the article, and revising it. All authors have read and approved the final manuscript.

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## **Copy-cat Bot for Narendra Modi which generates plausible new speeches in Modi's style using machine learning approaches**

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### **Abstract**

Many consequences in the human past can be traced back to that one well-written, well-presented speech. Speeches grasp the power to move nations or touch hearts as long as they are well-thought-out. This is why gaining the expertise of speech giving and speech writing is something we should all intent to gain. A copy-cat bot is a model that can learn the writing and talking style of a certain person and replicate it. The main objective of this research study is to apply simple Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM) Recurrent Neural Networks and Gated Recurrent Unit (GRU) in developing a speech generation system that deep learns one text and then generates new text. This research looks into the generation of English transcripts of Narendra Modi's speeches. The generated text using LSTM and GRU models has great potential. The output resulted by RNN is less realistic and pragmatic, but its variants LSTM and GRU performed better. Though the grammatical correctness and the sentence transitions were absent in generated text of LSTM and GRU, but their output is somewhat logical as compared to RNN. LSTM and GRU performed better as it generated more realistic text and training loss is small, perplexity is small and mean probability is high compared to RNN.

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