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Development of a Simple Food Safety Model for Sustainable Food Security of University Cafeteria

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Abstract—*Food safety is vital approach for any community to sutain their health from harmful effect occurred by unhygienic food consumption. This study aimed to develop a food safety model which can be implemented conveniently with minimum work environment changes to ensure sustainable food security within university community. Food Samples (Curry and Meat) from the university cafeteria were collected. Collected food samples were tested for coliform and subsequently for Escherichia coli and with three fold dilutions serious. Swab samples from workers hand were tested for fecal coliform test. Recommended hand washing method and food safety practices were introduced to university cafeteria as a food safety model. Swab samples from workers and foods samples of cafeteria were analyzed for aforementioned microbiological parameters followed by two weeks of acclimatization period. Visual observation and interview method were adopted to confirm the hand washing procedure of workers. Weekly periodic validation tests were performed to monitor the progress of the food safety model. All measurements were carried out in triplicate (n=3), and results were subjected to a one-way analysis of variance (ANOVA) using Minitab 16 software (Minitab, Inc., USA). Differences between means were determined by the least significant difference test at P < 0.05.*
Results were negative for Salmonella in all samples. Mean comparison of microbial colonies demonstrated, both coliform count and Escherichia coli in food samples and swab samples have significantly reduced after continuous practicing of recommended hand washing methods (p <0.05). Periodic validation tests further revealed food safety model has successfully maintained the results well below the initial stage. The results of the study concluded continuous practicing of recommended hand washing methods and food safety model has increased the food hygiene and it ensures the sustainable food security of the university cafeteria and its community.

Keyword*: food, safety, model, sustainable, security, cafeteria*

1. INTRODUCTION

Food safety is describing handling, preparation, and storage of food in ways that prevent foodborne illnesses**.** Food safety is the responsibility of those who handle and prepare food commercially to deliver to consumers and consumers who prepare and eat food in their homes. Foodborne illness or food poisoning may cause by bacteria that grow on food which spread because of food not clean, stored, or handled properly [1]**.** So improvement of food safety is very important to avoid the foodborne illnesses by handling the proper hygiene methods. Some severe diseases can be occurred causing bacteria, viruses and chemicals [2]. Threats to health can enter the food supply at many points along the supply chain, including food production, processing, distribution, storage, preparation and retails [2]. Microorganisms are the dominant sources of the food poisoning and the foodborne illnesses specially bacteria such as the *Salmonella* and E-coli [3]. *Salmonella* is a type of enteric bacteria lives in the animal digestive track opportunistically and causes salmonellosis in the animals making them unsuits for the consumption. They are non-spore-forming, predominantly motile enterobacteria with diameters around 0.7 to 1.5 ìm, lengths from 2 to 5 ìm, and peritrichous flagella (flagella that are all around the cell body). They are chemoorganotrophs, obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes [3]. E-coli is an organism belongs to the group of enteric bacteria (Enterobacteriaceae) and lives opportunistically in the digestive tract of warm blooded animals and capable of becoming pathogenic when the number has increased [4]. They expose to the outer environment via the fecal matter of contaminated and diseased animals and healthy animals may get contaminated and diseased by feeding on feed and water and from litter contaminated by this fecal matter from diseased animals.

Foodborne diseases occurred basically due to poor handling of food poor processing and distributions [3]. Implementing proper food handling, processing and distribution method can be minimized to outbreak of the foodborne illnesses [5]. Hygienic practices can efficiently reduce the adverse effect of the microorganisms [3].

Food safety has emerged as an important global issue with international trade and public health implications. In response to the increasing number of food borne illnesses, governments all over the world are intensifying their efforts to improve safety of food [6]. The World Health Assembly adopted a resolution (WHA 53.15) in which, the World Health Organization (WHO) was asked to give greater emphasis on food safety with the goal of developing suitable integrated food safety systems for the reduction in health risk along the

entire food chain, from primary producer to the consumers. Food safety programs have become increasingly necessary due to technological advances in food and agricultural sectors and also due to social changes introducing new food habits. In the past, food was consumed by those who produced it or by their immediate neighbors. Increased world production, urbanization, industrialization and migration have however introduced new food safety problems into our food supply [6]. In Sri Lanka, there has been growing incidence of food safety and quality risks in recent years and as a result considerable lives have claimed. According to the medical report of university medical center, recently many of the student whom eat from university cafeteria had food borne illnesses just after coming in to the university and that has been reported every times students returned to the university after vacations.

This study was planned with the objectives to develop a simple food safety model for the university cafeteria to ensure sustainable food security within university community and deliver safe and hygienic commodities to its intended users.

2. MATERIALS AND METHODOLOGY

2.1. Sample Collection and preparation

Food Samples (Curry and Meat) were collected in to sterilized polyethylene bags from the cafeteria in the University. Sterilized stainless steel spoons were separately used for the sample collection. Subsequently swabs samples from the workers hand were collected. 10 g of food samples were homogenized using a sterile commercial blender (Jaipan Family Mate: IS 4250, India) for 1 min and diluted in to the 90 mL of peptone water, that peptone water (Himedia, India, 15 g/L), then 1 mL of bulk sample was used to obtain the final 10 mL dilution with 10^{-3} concentration.

2.2. Microbiological Analysis

Coliform test

Coliform test was done for both food samples and swab samples from the workers hand. 1 mL of samples diluted food sample was speared on Mcconkey agar (Oxoid, England) selective medium. Sterilized cotton buds used for swab sample collection were streaked on the Mcconkey medium. Both samples were incubated at 37^{o}C for 24 hr and pink colour colonies were checked on the Mcconkey medium.

***Escherichia coli* (*E. coli*) test**

1 mL of homogenized samples were spread in each pre-poured and dried standard Eosin Methylene Blue Agar media (Oxoid, England, 37.5 g/L) and then incubated at 37^{o}C for 24 hr. Typical *E. coli* colonies were counted as colony forming units (CFU) after the incubation period using a colony counter (Galaxy 230) and the results were expressed as log10 CFU/g of the food sample [7].

***Salmonella* identification test**

1 g of each sample was measured into a sterile vacutainer and 10 ml of peptone water (Himedia, India, 15 g/L) was poured in. Then, the sample was mixed well using a vortex mixer (Jeiotec: VM 96B, Korea) and kept in a 37^{o}C incubator (Gemmy 888, Taiwan) for 48 hr. After incubation, samples were spread on the pre-poured replicate plates prepared with dried standard Xylose-Lysine-Deoxycholate Agar (Oxoid, UK, 3 g/L). The inoculated plates were kept in the incubator at 37 °C for 24 hr to detect the presence of *Salmonella* [8].

2.3. Food safety model

Proper hand washing method with an appropriate hand sanitizer was introduced. Workers were strictly advised for rubbing hands together for 20 seconds to cover all surfaces of palm and fingers after applying the hand sanitizer to the wet hand and washing the hand with running tap water before starting any food preparation steps. Subsequently they were advised to dry the hands properly using a clean towel. Meanwhile wearing head caps were recommended for workers at the entrance to the food processing area. Two weeks adaptation period was declared for the workers and the malpractices were adjusted during the period. Subsequently recommended practices of the food safety model were frequently monitored through the security camera system of the cafeteria and direct interview method.

Total procedure was repeated after one month of period to investigate the progress of the introduced food safety model to the university cafeteria. Results of microbiological analysis were contrasted with initial stage of the study.

2.4. Statistical Analysis

All measurements were carried out in triplicate (n=3), and results were subjected to a one-way analysis of variance (ANOVA) using Minitab 16 software (Minitab, Inc., USA). Differences between means were determined by the least significant difference test at $P < 0.05$.

3. RESULTS AND DISCUSSION

Number of mean colony count was contrasted before and after the successful implementation of the food safety model to the university cafeteria.

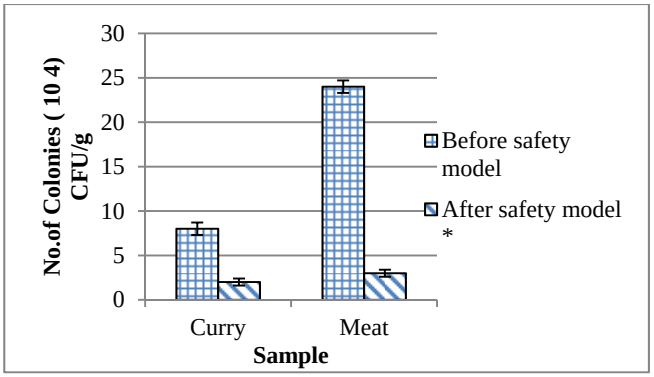

Fig. 1: Coliform count of food samples

* mean colony count of food samples after implementing the food safety model were significantly different ($p< 0.05$).

Results of the coliform count emphersize, the introduced food safety model has greatly affected the number of microbial colony and moreover recommonded hand washing practice has significantly reduced the germs (Fig. 1). On the other hand Fig. 2 shows the significant reduction of the E-coli count of the food samples after implementing the food safety model in the university cafateria. Mean colony values for the curry samples (before and after) were 15 and 2.28 respectively and approximately it is seven time reduction of colonies in food. Colony count of meat samples (before and after) have also showed significant reduction, where the mean value of colonies were 10 and 3.33 respectively. It has been investigated restaurants, fast food restaurants, distribution centers, stored to check the good hygiene practices, good manufacturing practices, HACCP principles and general knowledge about the production and preparation of foods and data was collected for E coli microorganism and it has been clearly stated hygiene practices have prominently influenced the food safety [9].

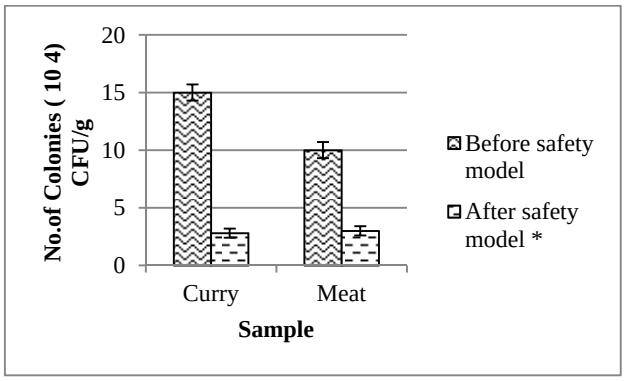

Fig. 2: E-coli results of the food sample in cafeteria

* mean E-coli colony count of food samples after implementing the food safety model were significantly different ($p < 0.05$).

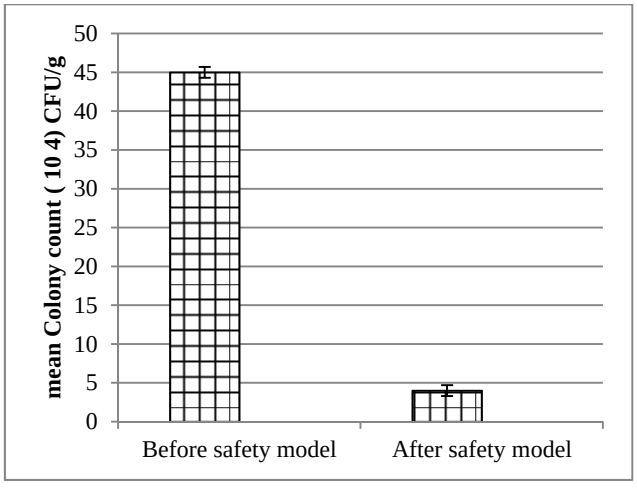

Fig. 3: Fecal Coliform of swab samples from workers of cafeteria
* mean colony count of food samples after implementing the food safety model were significantly different ($p < 0.05$).

Fig. 3 explains swab test results of fecal coliform test for the worker's hands in cafeteria. Considering the colony count before and after implementing "hand washing" there was a prominent reduction in colony count after implementing the safety model. Similar work was carried out and it has been clearly indicated reduction in microbial count was observed after proper hand washing practices prior to the food preparation [9].

Furthermore, results related to *Salmonella* analysis were negative for all samples. Effectiveness of the recommended food safety model on *Salmonella* was not well demonstrated in this study.

4. CONCLUSION

Study concluded that results were negative for *Salmonella* in all analyzed curry and meat samples. Mean comparison of microbial colonies, for coliform count, *Escherichia coli* in food samples and fecal coliform in swab samples have more emphasized the effectiveness of recommended hand washing methods moreover results of the study has firmly highlighted continuous practicing of recommended hand washing methods as a food safety model has increased the food hygiene in terms of microbiological quality and it ensures the sustainable food security of the university cafeteria.

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