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Mini Review

An overview of foodborne illness and food safety in Malaysia

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Abstract

Foodborne disease has been associated with microorganisms like bacteria, fungi, viruses and parasites. Most commonly, the outbreaks take place due to the ingestion of pathogenic bacteria like *Salmonella* Typhi, *Escherichia coli*, *Staphylococcus aureus*, *Vibrio cholera*, *Campylobacter jejuni*, and *Listeria monocytogenes*. The disease usually happens as a result of toxin secretion of the microorganisms in the intestinal tract of the infected person. Usually, the level of hygiene in the food premises reflect the quality of the food item, hence restaurant or stall with poor sanitary condition is said to be the contributor to food poisoning outbreak. In Malaysia, food poisoning cases are not rare because the hot and humid climate of this country is very suitable for the growth of the foodborne bacteria. The government is also implementing strict rules to ensure workers and owners of food premises prioritize the cleanliness of their working area. Training programme for food handlers can also help them to implement hygiene as a routine in a daily basis. A lot of studies have been done to reduce foodborne diseases. The results can give information about the types of microorganisms, and other components that affect their growth. The result is crucial to determine how the spread of foodborne bacteria can be controlled safely and the outbreak can be reduced.

Introduction

Foodborne outbreaks have been reported with significant morbidity worldwide and pose risk towards human population. Concurrently, in less developed country, diarrhoeal diseases are the primary reason for mortality (Schlundt *et al*., 2004). In a global scale addition, diarrhoeal disease has caused 3% mortality (World Health Organization, 2014) and should be a great concern. In industrialized country, foodborne diseases are not rare because 30% of the global population experienced foodborne diseases each year. Incidence rates has been reported to be 1210 cases per 100,000 inhabitants in France, 2600 cases per 100,000 in the United Kingdom, and more than 25, 000 cases per 100,000 inhabitants in Australia and the United States (Teisl and Roe, 2010).

Cases of foodborne illness in Malaysia is lower compared to these countries because most of the cases go unreported and a chain of events need to be addressed first before it is brought to the authority (Soon *et al.*, 2011). Foodborne bacteria can be transmitted at difference stages of food preparation. These include contamination at the farm, for example milk is contaminated with animal faeces, or the animals are already been infected by pathogenic microorganisms. Transmission can also occur during slaughtering where meat come into contact with animal intestine, skin or fur and finally in the kitchen during food preparation due to improper handling (European Food Safety Authority, 2014).

Foodborne diseases occur due to the ingestion of bacteria, viruses or parasites which multiply in the intestine and cause illness or consumption of non-infectious agents like toxin and chemicals (Linscott, 2011). Common symptoms of foodborne illness are diarrhea which sometimes accompanied with nausea and vomiting. Several factors contribute to foodborne illnesses like lack of self hygiene of food handlers, no clean water supply and unclean environment

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(Meftahuddin, 2002). Food handlers are the most common source of contamination because they can spread harmful organisms by means of fecal-oral route or skin lesions, as well as unclean kitchen utensils or kitchen counters (Linscott, 2011).

In general, the frequent sources of foodborne outbreaks are meat, dairy products, eggs and vegetables whereas the common agents of foodborne outbreaks are *Salmonella* Typhi, *Staphylococcus aureus*, *Escherichia coli* and *Clostridium perfringens* (Pires *et al*., 2012). The correct food handling practices in every step of food preparation is essential to avoid contamination from the environments, food handlers and rare to cooked or ready-to-eat (RTE) food items.

Ready to eat or prepared food has become a necessity due to fast pace of living nowadays. In Malaysia, the limitation of time for most people to prepare meals for themselves has increased the demand for food consumption from various food service establishments and it has also becoming a trend for most of Malaysian to eat out (Ali and Abdullah, 2012). However, some food premises neglect the importance of hygiene and sanitation and thus, increase the risk of foodborne illness among the consumers. Food handlers are also the main food contamination vehicles (Campos *et al*., 2009), and their level of practice in the kitchen plays an important aspect on the distribution of harmful microorganism from the environment to the food items. Sometimes consumers give prioritization on the low price of the food that they purchased instead of the hygiene level of the food premises. This will convince food handlers that as long as the price for their meal is cheap, they do not have to concern about food safety.

Foodborne diseases

The outbreak of foodborne disease is defined as the occurrence of two or more cases of similar illness due to the consumption of food (Soon *et al*., 2011). Foodborne illness can be caused by bacteria, virus and parasite. Most foodborne illnesses like cholera, typhoid fever, hepatitis A, dysentery and food poisoning are associated with acute gastrointestinal symptoms like diarrhea and vomiting (Blackburn and McClure, 2002).

Generally, cholera is a foodborne disease due to the infection of *Vibrio cholera* in the intestinal tract. The symptoms including acute severe watery diarrhoea sometimes accompanied with vomiting. *V. cholera* can be easily isolated from seafood such as cockles and oysters (Tobin-D'Angelo *et al*., 2008). Typhoid fever is a disease caused by bacteria called *Salmonella* Typhi (Yanagi *et al*., 2009) and the symptoms of infection are fever with body temperature increasing to 39°C to 40°C, headache, loss of appetite, and stomach ache. Typhoid fever can easily spread from contaminated food and water or from infected human or carrier (Parry and Beeching, 2009).

Hepatitis is a disease that affects the liver. It is caused by a virus called hepatitis A virus (HAV) that can be transmitted via contaminated food and drink. Symptoms of illness include jaundice, dark urine, anorexia, malaise and extreme fatigue (Sharifa Ezat *et al*., 2013). Dysentery is an infection that leads to severe diarrhea that contains mucus and/or blood in the faeces, vomiting blood or in some serious cases result in death if no treatment is given. Example of organisms that causes dysentery is *Entamoeba histolytica*, a parasite that causes amoebic dysentery (Xun *et al*., 2009) and *Shigella dysenteriae* that causes bacillary dysentery (Sharma *et al*., 2010).

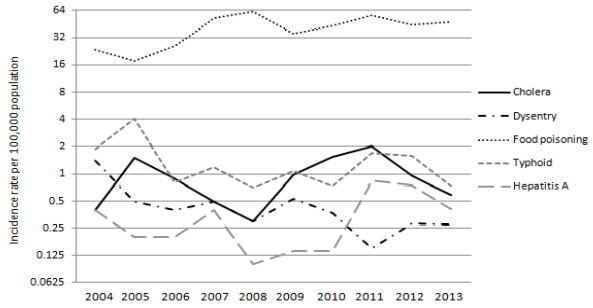
Cases in Malaysia

Malaysia is one of the countries that have high cases of foodborne diseases due to the suitable temperature and condition for the growth of most bacteria. During invasion of pathogens, skin, mucus and intestinal microflora become the first barrier to avoid illness. The last defence mechanism would be the immune system that protect human when the first barrier is affected (Bezirtzoglou and Stavropoulou, 2011). Nevertheless, the immune systems and gut microbial communities depend on human diet which is indirectly influenced by socioeconomic status, culture, population growth and agriculture (Kau *et al*., 2012). This explains why people from different backgrounds and countries have different tolerance towards poor hygiene food prepared here. It proves that cleanliness is important during food preparation to avoid contamination of food items and illness among local and international consumers. This is because the occurrence of foodborne disease will affect economic growth of the seller as well as the country due to changes in consumers buying patterns (Palma *et al*., 2010).

In Malaysia, foodborne diseases are not rare. A fact remains that not all cases of food poisoning are reported because most of the affected persons do not seek treatment at the hospital, especially if the cases are not serious. To top it all, before a case can be reported to the authority, a complex of chain called population exposure, must occur first. As an example, a hundred persons eat the same food, then 40 persons become sick and 10 persons went for treatment. After

that, the doctor will request for a specimen from some of these patients, and then send them for analysis in the laboratory. Finally the culture-confirmed case will be reported to the Ministry of Health (Soon *et al*., 2011).

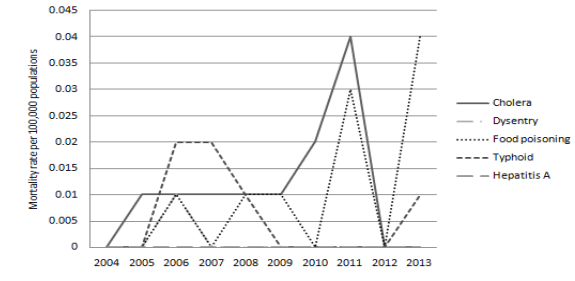
The trends of food and waterborne diseases in Malaysia vary over the past few years. There was an increase of cholera, food poisoning and hepatitis A from 2009 to 2011, but a decrease of dysentery. From 2011 to 2013, cases of cholera, typhoid and hepatitis A decrease but dysentery showed an increment. Furthermore, food poisoning cases decrease in 2012 but slightly increase in 2013 (Figure 1).



Diseases	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Cholera	0.4	1.5	0.9	0.5	0.3	0.98	1.56	2.02	0.96	0.58
Dysentry	1.4	0.5	0.4	0.5	0.3	0.54	0.37	0.15	0.29	0.28
Food poisoning	23.89	17.8	26	53.2	62.5	36.17	44.18	56.25	44.93	47.79
Typhoid	1.9	4.1	0.8	1.2	0.7	1.07	0.74	1.71	1.58	0.73
Hepatitis A	0.4	0.2	0.2	0.4	0.1	0.14	0.14	0.84	0.75	0.41

Figure 1. Incidence rate of food and waterborne diseases (MOH, 2014)

The increase of food poisoning cases might indicate that the food handlers have been neglecting the importance of safe food handling in the kitchen. Mortality has been shown to be associated with cholera from 2005 to 2011, but none was reported for the next two years. In 2012 none of the diseases cause mortality, however in 2013 food poisoning and typhoid was shown to cause death of Malaysian citizen (Figure 2).



Diseases	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Cholera	0	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0	0
Dysentry	0	0	0.01	0	0	0	0	0	0	0
Food poisoning	0	0	0.01	0	0.01	0.01	0	0.03	0	0.04
Typhoid	0	0	0.02	0.02	0.01	0	0	0	0	0.01
Hepatitis A	ND	ND	ND	ND	0	0	0	0	0	0

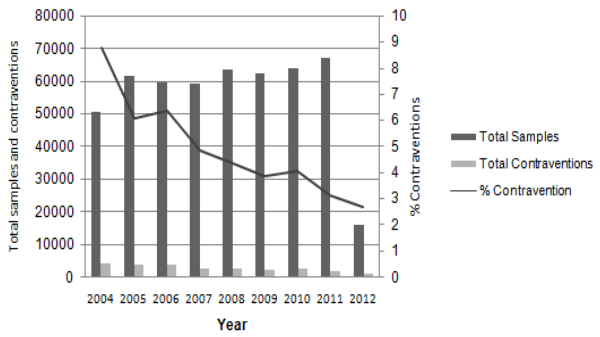
*ND= Not determine

Figure 2. Mortality rate of food and waterborne diseases (MOH, 2014)

Malaysian government has implemented few rules to ensure owners of food premises abide by the rules to avoid illness and outbreak. The hygiene level of the kitchen is the most important aspect that should be given attention because it will reflect the safety of the food to be consumed. In addition, the temperature in the kitchen is usually higher than the dining area which makes it a perfect condition to promote bacterial growth. It has also been proven that foodborne bacteria can grow on most of the surfaces in the kitchen like cutting board, cloth, sink, cleaning sponge and knives (Kusumaningrum *et al*., 2003; Mattick *et al*., 2003). Cross contamination to food could occur if those items are not properly clean and food handlers neglect the correct way of food preparation.

The main reason for foodborne illness in Malaysia is insanitary food handling procedures which contribute to 50% of the cases (MOH, 2007) for instance, the preparation of food in advance, inappropriate ways of cooling and insufficient temperature during reheating of food (Beumer and Kusumaningrum, 2003). All of these mishandlings permit the growth of microbial pathogens because they fail to kill the bacteria or they help to keep the bacteria dormant before they reach sufficient temperature to multiply. It is known that temperature play important part to determine the microbial activity and shelf life of food product (Aung and Chang, 2013). Hence, temperature manipulation, as well as hygiene and sanitation of kitchen environment should be the highest priority to ensure safe foods with low risk of contamination are served to consumers.

Ministry of Health Malaysia has been collecting food samples from various food premises to determine whether food service establishment prepare food according to the accepted requirement. Each year, more than 10,000 food items were sampled for analysis to determine whether food items are safe for consumption. From 2004 to 2012 the percentage of contraventions is decreasing (Figure 3).

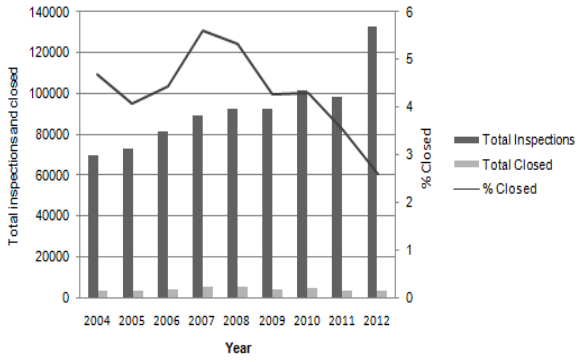


Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Samples	50492	61592	59492	59352	63411	62471	63973	67128	16250
Total Contraventions	4445	3750	3796	2873	2757	2426	2596	2101	1240
% Contravention	8.8	6.09	6.38	4.84	4.35	3.88	4.06	3.13	2.67

Figure 3. Contravention during food sampling between 2004-2012 (Food Safety and Quality Programme, MOH, 2013)

This shows that as the government enforce the law, food handlers make sure that they always incorporate high level of cleanliness during food preparation, thus reduce the numbers of contraventions.

In addition, food premise inspection is also crucial to ensure the level of hygiene in food premises. Around 70000 to 100000 of premises were inspected from 2004-2012. There was an increase in food premises closures from 2005 to 2007 but further decrease until 2012 (Figure 4).



Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Inspections	69813	73037	81686	88968	92597	92776	101799	98309	132526
Total Closed	3259	2973	3624	4984	4919	3962	4370	3458	3447
% Closed	4.67	4.07	4.44	5.6	5.31	4.27	4.29	3.52	2.6

Figure 4. Food premises inspection and closures 2004-2012 (Food Safety and Quality Programme, MOH, 2013)

The increase of food premise closures and law enforcement might motivate owners to boost their premises hygiene level.

The government has implemented laws regarding the hygiene level in the food premises. Any premise that is categorized as dirty will be forced to close down its operations. This is to avoid foodborne outbreak to occur because, apart from getting sick and experience diarrhoea, foodborne diseases can cause mortality and it can easily affect the young, old and immunocompromised person compared to other healthy individuals (Gorman *et al*., 2002). In Malaysia however, most of foodborne diseases are associated with food handlers' insanitary procedure during food manipulation (Soon *et al*., 2011) whereby improper food handling might transfer pathogenic bacteria to food item and cause illness.

The contamination of bacteria to food items is also influenced by several factors like temperature during storage, composition of gases, humidity, interaction between microorganisms and the food, as well as between microorganisms contaminating the food (Hamad, 2012). As consumers, we can always avoid getting foodborne illness by choosing the right food and the right place to dine. Malaysia authority classifies food premises according to their level of cleanliness. Grades like A, B, C and D or "no grade" has been applied to categorize food premise based on their level of sanitation. Several aspects that determine the grades including location, water supply, pest control, ventilation, food storage, toilet room, food handlers' clothing and health condition, food preparation, temperature, and so forth (Food Safety and Quality Programme, MOH, 2013).

Food premises grading systems

Food premise grades are given by local authorities and sometimes the score is different from one district to another. In general, grade A is given to a clean premise that obtain 76 to 100% marks. The following inspection will be done after a year and if the grade decline, the next inspection time will change. Grade B is issued to moderately clean food premise that obtain 50 to 75% marks. The subsequent inspection will be carried out in six months. Finally grade C is given to unclean food premise. This premise will have to close down its operation for two weeks. After that, another premise inspection will be done to determine whether this premise is competent to run its business again (Ali and Abdullah, 2012).

Grades of food premises will help people by giving an overview of the level of hygiene and sanitation of the food premise. Unacceptable food hygiene level is an indication that eating at the premises will increase the risk of foodborne diseases (Lee *et al*., 2012; Djekic *et al*., 2014). However, studies have proven that incidence of foodborne illness still occur in a clean and well-known restaurant (Simonne *et al.*, 2004; Walczak and Reuter, 2004; Alsop, 2013). Therefore food handlers are the most important individuals in ensuring that food is always safe for consumption. In addition, it is compulsory for every food handler to attend food handlers training programme held by Food Safety and Quality Division, Ministry of Health, Malaysia. This programme is important to create awareness among food handlers about the significance of personal hygiene and sanitation in the premises (Food Safety and Quality, MOH, 2012).

Future research of foodborne bacteria

Foodborne bacteria has been shown to cause significant morbidity worldwide. They can also adapt to new environment and stress to create a new strains of bacteria which is more powerful. Future research should focus on how to prevent or reduce the situation. This is because foodborne bacteria will also evolve and creating vaccine or antibiotic might do a little help only.

Cases of foodborne illness have an impact on

the economy too. Future research should also try to find a solution on how to educate the people especially the food handlers to practice correct hygiene measures. Some food service establishment is practising Hazard Analysis and Critical Control Point (HACCP) which is important to ensure their product is safe for consumption and if there is any defect during the production, it can be easily detected using this principal. However, many companies are still ignoring the importance of HACCP. Perhaps, future research can try to recognize the reason for the small involvement, thus finds a solution to attract other companies to practice HACCP system.

Another research can also be done to determine the most effective ways to reduce contamination from the farm in the first place. This is because the condition during food processing can cause the build up of microorganism, and finally the consumer will be the most affected person. Somehow, if the contamination is avoided earlier, foodborne disease can be avoided. For example, the temperature in the slaughter house can be manipulated to reduce contamination or microbiological test can be done regularly to check for the occurrence of certain bacteria.

Food services can also give a significant impact to the economy. Foodborne disease in a certain places gives a bad name and reduces consumer preference. High turnover rate among food handlers cause a difficulty on applying the correct practices. This is because, food handlers are required to attend specific courses on food handling and if new employees without the experience work in the food service establishment, they might cause foodborne illness due to mishandling and lack of knowledge. Future research can determine the correct measures on how to guarantee that each employee received the training before or as soon as they start working. For example, the trainer can give hands on training at the premises during break time.

The diversity of foodborne bacteria and their constant evolution required advanced procedures to detect and to combat their occurrence. To achieve the target, we have to know the condition that permits their growth and other factors that influence the incidence of foodborne bacteria. This is due to the reason that physical factors like food premise grades, food handlers sanitary level and kitchen condition might not necessarily contribute to food poisoning cases. The interaction between different types of bacteria and intrinsic factors like moisture content, pH and antimicrobial effect might suppress or promote their growth. For that reason, advanced methods that produce accurate result instantly are very important.

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