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Investigation on food poisoning outbreak associated with consumption of *Laksa Kebok* in Baling, Kedah

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Abstract

On the 7th of October 2018, Baling District Health Office was alerted on the admission of nine patients to Hospital Gerik, Malaysia for acute gastroenteritis following the consumption of *Laksa Kebok*, which was bought at Kupang, Baling, Kedah, Malaysia on the 4th of October 2018. The present work thus aimed to confirm and identify the epidemiological characteristics and causative agent related to the outbreak. The investigation team performed active and passive case detection to identify cases involved in this outbreak. A case was defined as any individual who had consumed *Laksa Kebok*, bought from a stall in Kupang, Baling, Kedah, Malaysia on the 4th of October 2018 onwards, and exhibited symptoms such as diarrhoea, vomiting, abdominal pain, or fever. The team also evaluated the hygienic status of sanitation, food, and water supply at the food premises involved. All clinical and environmental samples were sent for chemical and microbiological tests. An attack rate of 93.2% (n = 83/89) was recorded from a total of 89 people from three states that had consumed the *Laksa Kebok.* Majority of the cases involved women, with a mean age of 31 years. The most frequent symptoms were diarrhoea (86.7%), fever (65.1%), vomiting (53.0%), and abdominal pain (50.6%). Less than 10% of the cases were hospitalised and treated symptomatically, while two deaths were reported from this outbreak. The epidemic curve showed that the incubation period was between 8.5 and 26 h. The likely causative agent was identified as *Salmonella enterica* serovar Weltevreden. Inadequate knowledge and improper practices of food handling and preparation had contributed to food contamination. This outbreak was likely caused by the dough used to make the *laksa* noodles being contaminated by *Salmonella* Weltevreden. Health education on the importance of food safety and quality for the consumers and food handlers should be developed, improved, and implemented.

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Introduction

Food poisoning is an acute illness following food or water consumption contaminated either by bacteria, viruses, parasites, or chemicals (AFP, 2015). Individuals with food poisoning are usually presented with an acute onset of gastroenteritis-like symptoms such as vomiting, diarrhoea, fever, and abdominal cramps (AFP, 2015; Healthline, 2015). Food poisoning is commonly related to improper hot/cold holding temperatures of potentially hazardous food, improper cooking temperatures, dirty or contaminated cooking utensils and equipment, poor health and hygiene of food handlers, and food from

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unsafe sources (NHS, 2017). The majority of foodborne disease outbreaks result from inadequate knowledge and malpractice during food preparation (Campos *et al*., 2009; Mustaffa *et al*., 2017).

In Malaysia, all food poisoning and dysentery cases are required to be notified under the Prevention and Control of Infectious Diseases Act 1988 (MOH, 2017). An episode of food poisoning outbreak is defined as two or more people with illness associated with a common food or meal, which is epidemiologically related either by time, place, or person (WHO, 2008; MOH, 2017). According to a report by the Ministry of Health Malaysia, the national incidence rate of food poisoning was 62.5 per 100,000 population in 2008, and it had gradually decreased over the years to 45.7 per 100,000 population in 2018 (MOH, 2019). Nevertheless, the total episodes of food poisoning (outbreak) have surged from 420 to 500 cases over the same period (MOH, 2019).

The foodborne disease surveillance in Malaysia includes mandatory notification, laboratory-based surveillance, syndrome surveillance, and hospital-based surveillance. *Salmonella* is one of the bacteria investigated under Malaysia's laboratory-based surveillance system since 2002 (MOH, 2005). All isolated *Salmonella* species from various laboratories (hospitals or clinics) were sent to the Regional Public Health Laboratory in Ipoh, Malaysia and the National Public Health Laboratory (NPHL) in Sungai Buloh, Malaysia for serotyping test. *Salmonella enterica* serovar Weltevreden is the second most common *Salmonella* strain isolated from clinical sources in Malaysia, between the year 2003 and 2005, after *Salmonella* Enteritis (Thong, 2006).

Laksa is one of the Southeast Asian popular cuisines with many variants across the countries (Hegarty, 2017). It consists of thick wheat or rice noodles with chicken, prawn, or fish, and is eaten with spicy gravy, which is made of either coconut milk curry, sour tamarind-based gravy, or thick fish curry gravy. In Kedah, the *laksa* noodles are made from rice flour, served in thick mackerel gravy, topped with chopped lettuce and sliced boiled egg. The machine used to make the *laksa* noodles are known as '*kebok*'; hence the famous local *laksa* in Kedah is known as *Laksa Kebok*.

On the morning of the 5th of October 2018 (Friday), a family of seven were admitted to Hospital Gerik, Hulu Perak, Malaysia for excessive vomiting, fever, diarrhoea, and abdominal pain after consuming *Laksa Kebok* that was bought from a stall in Kupang, Baling, Kedah, Malaysia, a day earlier. One of the family members deteriorated and succumbed to death on the following day. Two individuals from another family were also admitted to the same hospital with a similar complaint. On the 7th of October 2018, the Hulu Perak District Health Office notified the Baling District Health Office of the possibility of a food poisoning outbreak, given the high number of affected cases and mortality reported.

The premises were asked to be closed on the morning of 8th of October 2018 for further investigation. The premises' owner was informed about the possible outbreak situation related to his *Laksa Kebok*. An alert was sent to the public and private health facilities to strengthen the surveillance on acute gastroenteritis and prompt notification on food poisoning cases associated with the history of consumption of *Laksa Kebok* on the 4th of October 2018 onwards. The investigation teams from respective districts were mobilised to initiate an outbreak investigation. The investigation was aimed to confirm the outbreak, identify the epidemiological characteristics, and the causative agent related to the outbreak. Based on these investigations, control measures would be implemented to prevent similar future cases.

Materials and methods

Epidemiological investigation

A case was defined as any person who exhibited symptoms of diarrhoea, vomiting, abdominal pain, or fever, and who had consumed *Laksa Kebok*, Kupang, Baling, Kedah, Malaysia on the 4th of October 2018 and onwards. Active case detection (ACD) was performed on the 8th of October 2018, to look for cases that match the case definition. The investigation team visited hospitals where all patients were admitted, and their respective houses to obtain information on the patients' conditions, clinical illnesses, and contacts. The e-notification system (Communicable Disease Communication Information System, CDCIS), the medical card from the nearest health clinic, and hospital emergency department were also reviewed for any relevant data related to the situation.

Environmental investigation

The investigation team visited the food premises where the *Laksa Kebok* was sold on the same day the notification was received. A list of customers who bought the *laksa* on the 4th of October 2018 and a week prior to the outbreak was retrieved from the premises' owner. The status of hygiene and sanitation of the food processes and water supply were evaluated. The investigation team also conducted a Hazard Analysis Critical Control Point System (HACCP) on the manufacturing process of *Laksa Kebok* to determine possible contributing factors associated with the food poisoning incident. The *Laksa Kebok* leftovers obtained from the patient's house, proxy samples of *Laksa Kebok* water, and environmental samples from the premises were collected and sent to the laboratory for further investigation.

Laboratory investigation

The *Laksa Kebok* leftovers were sent to the NPHL, Sungai Buloh, Malaysia for chemical and microbiological testings. Environmental samples, namely the cooking utensils, hand swabs of the food handler at the premises, environmental swabs, water, and proxy sample of *Laksa Kebok* from the premises were sent to the Food Safety and Quality Laboratory, Penang, Malaysia. A total of 31 stool samples were collected from the affected patients and the food handlers to rule out the possibility of any individuals being a carrier amongst them. Stool samples were sent to the respective hospital and public health laboratories. Bacterial isolates were sent to the NPHL, Sungai Buloh, Malaysia for further serotyping and molecular tests. DNA fingerprinting was performed by the Pulsed Field Gel Electrophoresis (PFGE) technique. Isolates with ≥ 85% genetic similarity threshold (cut-off) were grouped under one cluster.

Data analysis

A descriptive analysis was conducted based on several factors such as the person, time, and place, and the numerical variables were presented using the means or percentages. An epidemic curve was drawn with daily time steps at a 4-hour time interval. Distribution of the onset of symptoms and demographic characteristics of all of the cases were examined. All data were analysed using Microsoft Excel.

Results

A food poisoning outbreak occurred following the consumption of *Laksa Kebok*, and cases have been reported in three states; Perak, Kedah, and Selangor, Malaysia. A total of 89 people had bought and consumed the *Laksa Kebok* from Kupang on the 4th of October 2018, with 25, 34, and 24 people from Kedah, Perak, and Selangor, respectively, experienced symptoms of gastroenteritis. The cumulative attack rate was 93.2% (*n* = 83/89). From the 83 cases, 55 were women with the mean age of 31 years old. The most frequent symptoms observed were diarrhoea (86.7%), fever (65.1%), vomiting (53.0%), and abdominal pain (50.6%). Approximately 8.4% (*n* = 24/83) cases were hospitalised and managed with intravenous fluids and symptomatic treatment. They were discharged after 2 to 5 d of being treated in the ward. Two deaths were associated with this outbreak, and were reported from Perak, which contributed to the case fatality rate of 2.4% (*n* = 2/83). Sepsis due to infective acute gastroenteritis was reported as the cause of death for both cases. Nevertheless, no stool samples or gastric content were collected from these two patients to confirm the presence of the causative bacteria.

Figure 1 shows the outbreak's epidemic curve, which consists of cases from Kedah, Perak, and Selangor, Malaysia. Respectively, 25 and 34 cases were reported from Kedah and Perak state. Most of them had *Laksa Kebok* for tea or dinner on the 4th of October 2018. The first two cases presented with symptoms on the 5th of October 2018 at 0100 hour, approximately 8 to 9 h after consumption of the contaminated *laksa*, and the number of cases peaked in the next hours. The last symptomatic case from Kedah was reported on the same day at 1500 hour. Therefore, the minimum incubation period (IP) was approximately 8.5 h, while the maximum IP was 26 h. For cases from Perak, although patients exhibited the symptoms starting in the morning of the 5th of October 2018, most of them only sought treatment on the 6th of October 2018, approximately 20 h after consuming the contaminated *laksa*. Two deaths were reported, each on the 6th and 7th of October 2018. The last reported case which was admitted to the hospital was in the evening of 6th of October 2018.

Cases were also identified in Selangor. A case, who was on a vacation, had bought the *Laksa Kebok* (about 5 kg of only the noodles) on the 4th of October

2018, and brought it back to Selangor to be served in a gathering on the 5th of October 2018 at 1230 hour. About 25 people who had the *laksa* at the event were later identified as cases. The earliest onset of the symptoms was reported on the 5th of October 2018 at 2130 hour (min IP of 9 h), and the last onset was at 1500 hour on the 6th of October 2018 (max IP of 26 h). Based on all of the cases' IPs and symptoms, *Salmonella* was suspected as the causative agent of the food poisoning outbreak.

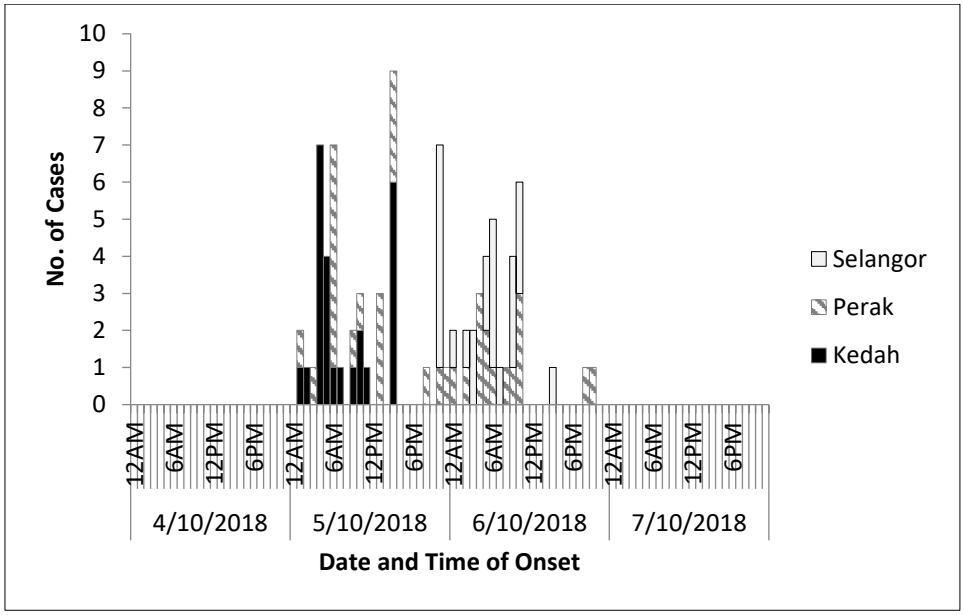

Figure 1. The epidemic curve of food poisoning outbreak in Kedah, Perak, and Selangor, Malaysia, following consumption of *Laksa Kebok* originated from Baling, Kedah, Malaysia on the 4th of October 2018 onwards (n = 83).

Environmental assessment findings

The stall that sold the *Laksa Kebok* was situated in front of the owner's house. He and four family members have been making *laksa* noodles in the house for the past 15 years. They produced approximately 30 to 50 kg of *laksa* noodles daily. The premises had two types of *laksa* noodles machine. Each of the machines could produce 30 to 50 kg and 100 kg of *laksa* noodles, respectively (Figure 2). The premises had three pipes for water supply; two of the pipes supplied chlorinated water by the state water service company, and the other pipe was connected to a tube well that was claimed to be used only to clean the premises' floor.

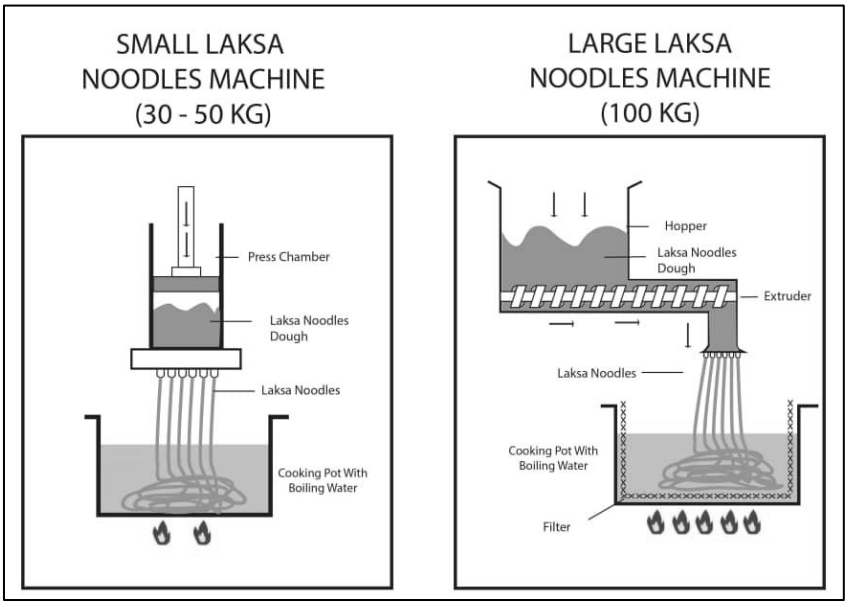

Figure 2. The *laksa* noodle machines used in the production of *Laksa Kebok*.

The HACCP inspection on the process of manufacturing of the *laksa* noodles, fish-based gravy, and chopped lettuce by the investigation team revealed the following:

i. *Boiling of laksa noodles*: Inadequate temperature for the purpose of boiling the *laksa* noodles following machine production because the burner was not working properly.
ii. *Thawing of frozen fish*: The defrosting process of the frozen fish, which is the main ingredient for the *laksa* gravy, was too long, which approximately took about 7 h. The dough for the *laksa* noodles was also kept in the same freezer with the fish, which may cause cross-contamination.
iii. *Storage and washing of lettuce*: Improper storage and washing of lettuce; the lettuce was not cleaned properly and thoroughly, and was placed in an icebox containing a single ice bag for 3 to 4 d. Unfinished *Laksa Kebok* were kept in the same icebox before it was sold again on the following day.

Laboratory findings

Salmonella Weltevreden was isolated from 16 stool samples. Other bacteria isolated were *Salmonella* Typhi, *Salmonella* Enteritidis, *Salmonella* Livingstone, and *Staphylococcus aureus.* The environmental samples of the tube well water, *laksa* gravy, and *laksa* noodles indicated that *Salmonella* Weltevreden was found in two of the samples, while *Salmonella* Agona was found in one sample.

The PFGE results showed that more than 99% of genetic similarity was observed for the 15 isolates of *Salmonella* Weltevreden, which were isolated from the patient's clinical samples and *Laksa Kebok*, hence, these isolates were grouped as one cluster. However, genetic similarity between patient isolates, *Laksa Kebok*, and the tube well water only achieved 75% similarity. Other chemicals and biological parameters were undetected or below the limit of quantification. No growth was detected from all swabs. Results of the sample from *Laksa Kebok* (proxy samples) and other environmental swabs were also negative.

Discussion

The food poisoning outbreak involved individuals from three states; Kedah, Perak and Selangor, Malaysia following the consumption of contaminated *Laksa Kebok*, which was bought on the 4th of October 2018 in Kupang, Baling, Kedah, Malaysia. This incident is in line with the definition of a food poisoning outbreak (WHO, 2008; MOH, 2017). A total of 83 people had an onset of food poisoning symptoms ranging from 8.5 to 26 h after consuming the *Laksa Kebok*. This finding is consistent with the usual incubation period of foodborne illness caused by *Salmonella* Weltevreden, which is usually from 6 to 48 h (CDC, 2018). Several patients, specifically from Perak, delayed in getting treatment from the nearest health facilities, which led to severe presentation and resulted in death. As mentioned earlier, some patients only went to the hospital a day after having symptoms. This finding highlighted the importance of the public seeking early medical treatment, following symptom onset of suspected food poisoning.

The epidemic curve suggested a common source of the outbreak with multiple exposures at different times and dates of consumption. *Salmonella* Weltevreden was isolated from stools and *laksa* noodles samples, and was likely responsible for this outbreak. Furthermore, the PFGE results showed an indistinguishable pattern of genetic similarity between the patients' and *Laksa Kebok* isolates.

The incidents of *Salmonella* Weltevreden in food poisoning has been well documented. The global *Salmonella* survey conducted by the World Health Organization revealed that this serovar is the most common cause of non-typhoidal *Salmonella* foodborne disease outbreak in the Southeast Asian and Western Pacific regions (Patrick *et al.*, 2004). *Salmonella* Weltevreden has been reported to be associated with fish or aquatic food production systems, and could also be found in domestic animals and humans (Thong *et al*., 2002). Several outbreaks related to non-typhoidal *Salmonella* have been reported in Malaysia. Between the years of 2013 and 2016, non-typhoidal *Salmonella* had caused four food poisoning outbreaks, involving more than 350 victims, and leading to eight deaths (New *et al.*, 2012).

The current outbreak was likely due to the contamination of the dough used for *laksa* noodles with *Salmonella* Weltevreden. Keeping *laksa* dough and other raw materials (fish) in the same freezer might have led to cross-contamination, and favoured the growth and development of pathogens, which could cause foodborne diseases (Campos *et al*., 2009). Other contamination sources could be from inadequate cooking temperature and insufficient time of boiling of the *laksa* noodles. *Salmonella* growth can be controlled by refrigeration below 4°C, or destroyed by cooking above 70°C (Finn *et al*., 2013). Improper cleaning of lettuce and later stored with unsold *laksa* noodles might have introduced the causative agent in this outbreak. This is based on previous local study findings that found various types of *Salmonella* species isolated from raw vegetables sold in local wet markets (Awang Salleh *et al.*, 2003). Overall, this *Laksa Kebok* outbreak merely resulted from inadequate knowledge and improper practices on food handling and preparation. This finding is in line with a study by Sharifah Ezat *et al.* (2013) which concluded that unhygienic food handling practices are the primary factor contributing to foodborne outbreaks in Malaysia which resulted in hospitalisation and deaths. However, the present work did not quantitatively measure the knowledge level of the food handlers involved. Therefore, it is recommended that an assessment on food handlers' knowledge be conducted as part of case investigation in future foodborne disease outbreak.

The present work's strength was the collaborative work between the public health teams, hospitals, and laboratories from the three states, which allowed prompt investigation, collection of various samples, identification of the source and measure to successfully contain the outbreak. Despite this, the team was not able to collect stool samples or gastric content from two patients who succumbed to death. This was because the patients' bodies had been released to their respective family for burial at the time this investigation was initiated. These samples were essential to confirm the presence of causative bacteria and its relation to the outbreak. Additionally, the present work was also limited by the unavailability of samples from *laksa* noodles sold on the 4th of October 2018. The investigation team only managed to get the proxy sample of the *laksa* noodles for laboratory investigation.

Conclusion

In conclusion, this food poisoning outbreak occurred following the consumption of *Laksa Kebok* from a stall in Kupang, Baling, Kedah, Malaysia. The bacterium responsible for this outbreak was identified as *Salmonella enterica* serovar Weltevreden. Following investigation, several malpractices during the handling and preparation of *Laksa Kebok* were identified as the source of contamination. Therefore, health education on the importance of food safety and quality among the consumers and food handlers should be developed, improved, and implemented to avoid recurrence of such outbreaks in the future.

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