



# A Large Common Source Outbreak of *Salmonella typhimurium* Linked to Kuala Terengganu Night Markets, Malaysia, 2014

Balkis Ab Karim<sup>1,\*</sup>, A Liza Latip<sup>1</sup>, Anita Surani Abd Shukor<sup>2</sup>, Norafidah A Rashid<sup>2</sup>, Wan Madiah Wan Mohd<sup>2</sup>, Fadzilah Kamaludin<sup>3</sup>

1 Terengganu State Health Department, Malaysia Kuala Terengganu District Health Office, Terengganu, Malaysia

2 Kuala Terengganu District Health Office, Terengganu, Malaysia

3 Office of Deputy General of Health (Public Health), Ministry of Health Malaysia

\*Corresponding author, email address: [dr.balkis@moh.gov.my](mailto:dr.balkis@moh.gov.my)

## Abstract

On 1 Mar 2014, the Terengganu District Health Office was notified of ten patients presented with acute gastroenteritis at Sultanah Nur Zahirah Hospital. Their illness was linked to consumption of foods from two night markets. An outbreak investigation was initiated to determine the source of the outbreak. Case finding was conducted in the hospital, and community. Patients were interviewed about demographics, symptoms and food consumption history. Stool samples from patients and food handlers as well as food and environmental samples were collected for laboratory analysis. Suspected food premises were inspected. A case-control study was conducted. Of 169 cases, 68.6% and 32.5% ate food from night markets A and B respectively while 1.2% ate food from both night markets. Major symptom was diarrhea (98.2%). There was one death from hypovolemic shock. *Salmonella typhimurium* was isolated from 13 patients and one food handler. All isolates showed genetic similarity by pulsed-field gel electrophoresis. The food handler tested to have the infection served the white fried rice sold in both night markets. Cases were 14 (95% CI = 4.05-46.61) and nine (95% CI = 3.36-24.3) times more likely to have consumed white fried rice from night markets A & B respectively. The source of infection was likely to be white fried rice that was prepared at the same place, contaminated by an infected food handler and sold at both night markets.

**Keywords:** Food poisoning, *Salmonella typhimurium*, night market, food handler

## Introduction

Night markets have been around for decades in Malaysia. They are called 'Pasar Malam' and are popular places for social gatherings. Makeshift stalls selling local products and foods are the main attractions at these sites.

The Local Authority in Kuala Terengganu District, Terengganu State, designates and licenses the locations of night markets. There are 22 designated locations and three to five locations are opened from 6 to 10 pm every day. Each location consists of 100 to 200 food stalls. The designated stall is usually an empty space of about nine square meters without basic infrastructure and amenities such as water supply, electricity, washing, and drainage facilities.

Food stall operators move daily to different locations following a weekly schedule. In the makeshift stalls, the operators sell cooked or partially cooked foods prepared from home or at the shops. Most vendors prepare food items at home in the morning and bring it to the night market in the evening.

Major foodborne outbreaks were observed to be associated with markets.<sup>1</sup> Hazards related to markets are common due to biological cross-contamination, polluted water, inadequate preservation and storage, and poor environmental sanitation.<sup>2</sup>

At 19:00 on 1 Mar 2014, the Emergency Department in Sultanah Nur Zahirah (SNZ) Hospital notified the Kuala Terengganu District Health Office of 10 cases of suspected food poisoning. A rapid assessment team was assembled to verify and assess the extent of the

outbreak, identify the causative agent and source, make relevant recommendations, and institute appropriate control measures.

## Methods

We interviewed the hospitalized and out-patient cases, and reviewed their medical records in SNZ Hospital. We searched for additional cases among out-patients attendance in health clinics and SNZ hospital, family members and friends of the acute gastroenteritis (AGE) cases who had history of consumed foods from Night Markets A (NMA) and B (NMB). Information was obtained on demographic details, date and time of onset of symptoms, and foods consumed, including the source of foods.

## Case-control Study

We conducted a case-control study to identify the potential vehicle of the outbreak. We defined a case as a person who developed one or more of the following signs or symptoms: diarrhea, abdominal pain, vomiting, fever, nausea, or dizziness after consuming foods from NMA or NMB on 28 Feb to 1 Mar 2014. Controls were family members and friends of cases and other vendors who consumed foods bought from NMA or NMB, yet did not develop symptoms of AGE. Logistic regression was used to calculate crude odds ratios.

Stool samples were sent for enteropathogenic bacterial culture at the laboratory in SNZ Hospital, and serotyping and pulsed-field gel electrophoresis (PFGE) at Institute of Medical Research in Kuala Lumpur. No clinical samples were collected from controls.

## Environmental Investigations

Food premises in NMA and NMB were inspected using a standard format for restaurants and food stalls issued by the Ministry of Health which covers food processing and storage, personal hygiene of food handlers, quality of cooking utensils, water supply and drainage system, solid waste disposal, and kitchen infrastructure. Food handlers were interviewed regarding food preparation and cooking methods of the suspected foods. Left-over raw food materials and ingredients from the kitchen and, environmental swabs from working surface and utensils were also taken.

We traced back the supply chain for chicken, eggs and vegetables. Food and environmental samples were taken from these premises and sent to the Terengganu State Health Department Food Laboratory for bacteriological testing.

## Results

### Descriptive Findings

Total 169 cases fulfilled the clinical case definition, including 116 (68.6%) had history of consuming food from NMA and 55 (32.5%) from NMB, with two (1.2%) cases consuming food from both night markets. No significant difference was observed in the demographic profiles of those who consumed foods at NMA and NMB (Table 1).

**Table 1. Characteristics of acute gastroenteritis cases from two night markets in Kuala Terengganu District, Terengganu State, Malaysia, 28 Feb to 1 Mar 2014**

	Night Market A (%) (n = 116)	Night Market B (%) (n = 55)
Mean age $\pm$ SD	22.80 $\pm$ 12.13	19.70 $\pm$ 12.13
Age group		
Adult	92 (79.3)	39 (70.9)
Child	24 (20.7)	16 (29.1)
Gender		
Male	55 (47.4)	26 (47.3)
Female	61 (52.6)	29 (52.7)
District		
Kuala Terengganu	97 (83.6)	49 (89.1)
Marang	13 (11.2)	4 (7.3)
Hulu Terengganu	4 (3.4)	0
Setiu	2 (1.7)	1 (1.8)
Treatment Status		(n=53)
In-patient	65 (56.0)	43 (81.1)
Out-patient	34 (29.3)	7 (13.2)
No treatment	17 (14.7)	3 (5.7)
Outcome		
Alive	116 (100.0)	54 (98.2)
Died	0	1 (1.8)

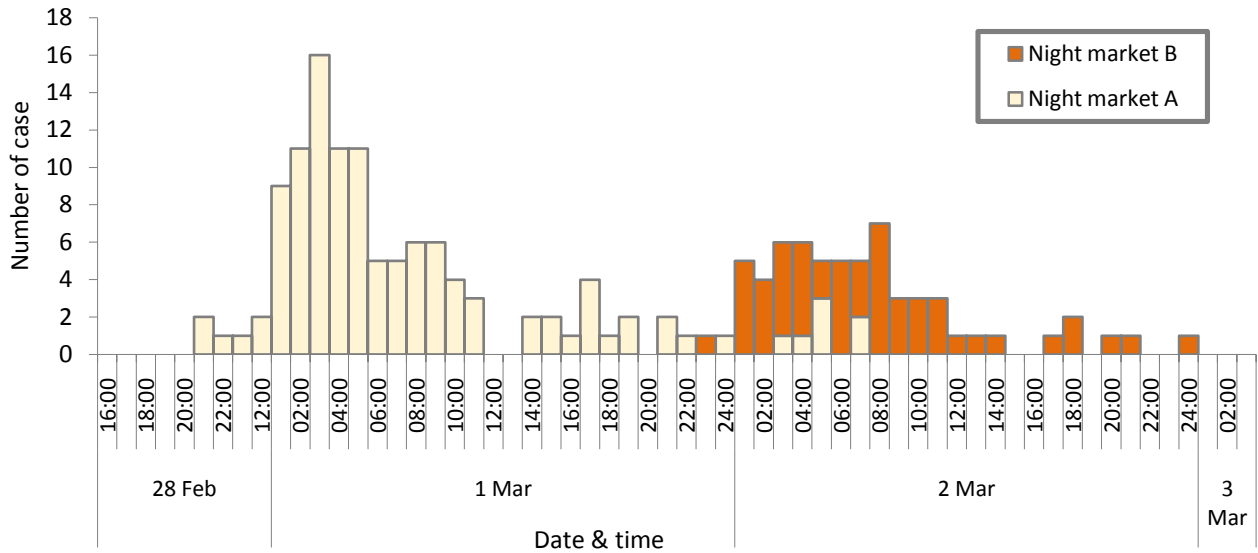
Major presenting symptoms were diarrhea (98.2%), followed by abdominal pain (91.8%), vomiting (78.4%), fever (63.7%), dizziness (49.7%), and nausea (46.2%).

The epidemic curve contained two peaks: the first peak consisted of cases with a history of eating food from NMA and the second peak with cases in NMB. Median incubation period of cases consumed food from NMA and NMB was 9.5 hours and 11 hours respectively (Figure 1).

About 63% of 169 cases were hospitalized (60% from NMA, 40% from NMB). One death was reported, the cause of death was hypovolemic shock secondary to severe dehydration (0.6% case fatality rate).

### Laboratory Results

Total 118 stool samples collected were from 107 cases



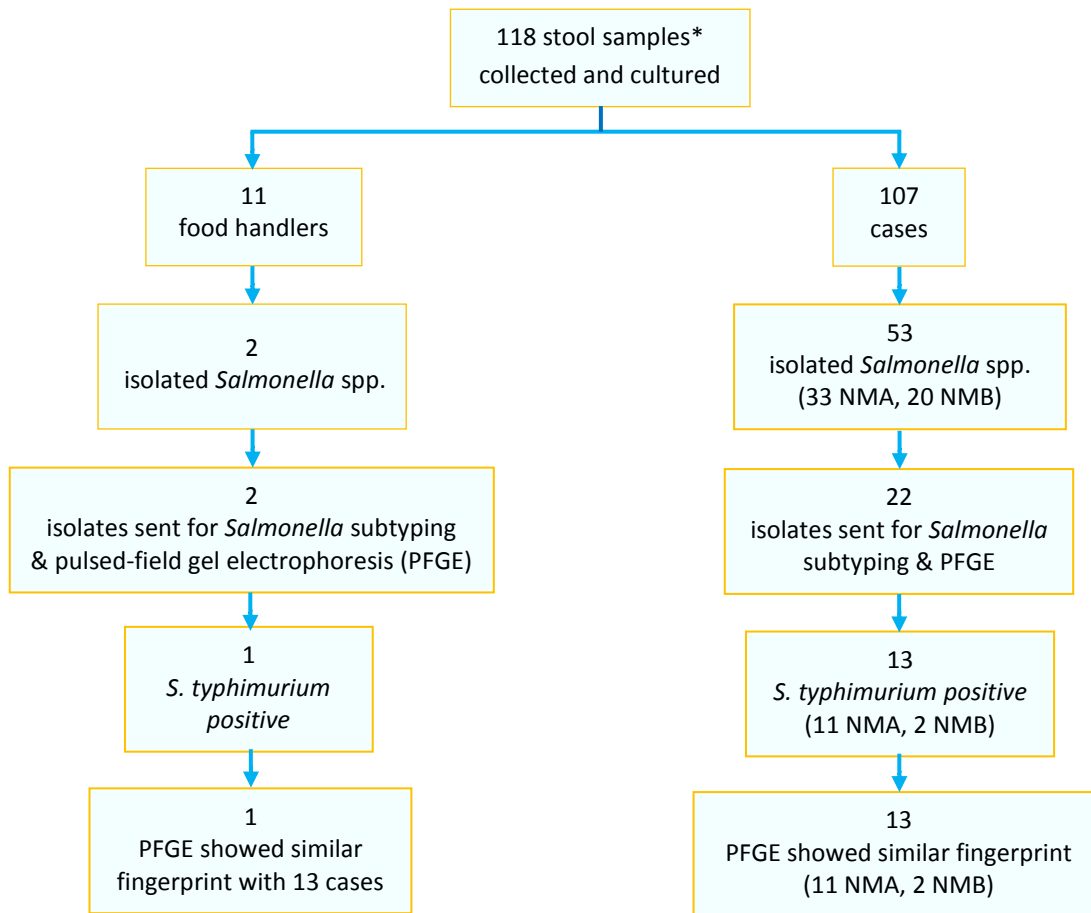
**Figure 1. Date and time of onset of acute gastroenteritis cases from two night markets in Kuala Terengganu District, Terengganu State, Malaysia, 28 Feb to 1 Mar 2014**

and 11 asymptomatic food handlers, and 100% were cultured. Among them, 53 (49.5%) out of 107 cases and two (18%) out of 11 food handlers were cultured positive for *Salmonella*. Of 55 isolates tested positive, 24 were sent for subtyping and PFGE, and *S. typhimurium* was detected in 15 (63%), including 13 cases and two food handlers. Fourteen isolates showed fingerprint similarity: 13 from cases

(including the fatal case) and a food handler who prepared white fried rice at both night markets (Figure 2).

**Case-control Study**

The data were stratified by night markets where the case bought the food items. Total 168 subjects (116 cases and 52 controls) consumed food from NMA,



\*No stool sample was taken from non-case.

NMA = Night market A, NMB = Night market B

**Figure 2. Laboratory investigation and results of acute gastroenteritis cases from two night markets in Kuala Terengganu District, Terengganu State, Malaysia, 28 Feb to 1 Mar 2014**

while 131 subjects (55 cases, 76 controls) consumed food from NMB. As there were two cases consumed food from both night markets, the number of cases were accounted based on each night market.

Cases were 14 (95% CI = 4.05-46.61) and nine (95% CI = 3.36-24.3) times more likely to have consumed white fried rice from NMA and NMB respectively (Tables 2 and 3).

### Environmental Investigation

The foods were prepared at a shop, and cooked and readily sold at a food stall named FS1 Kitchen in both night markets. Food premise inspection at the preparation shop scored 44.8% which was lower than acceptable score of more than 70%. Violation of food hygiene standard was identified at processing of raw materials, and storage of mixed raw materials and cooked food items (Figure 3). Temperature of the chiller was 16°C while the standard should be less than 8°C. No enteropathogenic bacterial isolated from 26 food and environmental samples taken from the kitchen. However, high count of coliform was detected.

The main ingredients of white fried rice sold at the FS1 kitchen were rice and chicken. Hazard analysis and critical control point (HACCP)<sup>3</sup> showed two main violation points. Chicken was prepared unhygienically. The half-cooked chicken were cut into small pieces, kept in a plastic container, mixed with gravy consisting of sugar, monosodium glutamate and salt, and left in the ambient temperature for two hours. The chicken was fried with rice at the night

markets. The ready-to-eat white fried rice was displayed in an opened big casserole for at least 4-8 hours at room temperature (Figure 4).

Out of 24 food samples taken from chicken, eggs and mixed vegetables, *Salmonella corvalli* were detected in fresh and semi-frozen chickens from the cool box.

### Discussion

The epidemic curve showed the outbreak occurred first at NMA and subsequently followed by another outbreak at NMB. Both showed similar point source pattern, with an interval of 1-day lag suggesting a common exposure. Those who consumed white fried rice sold at the FS1 kitchen in both NMA and NMB were found to have higher risk of getting ill.

The infecting agent was *S. typhimurium* and the cases had symptoms compatible to infection by *S. typhimurium*<sup>4</sup>. The source of the outbreak was the food handler from the FS1 kitchen who could have contaminated the white fried rice during food preparation. Isolation of *S. typhimurium* and the similar fingerprint pattern from cases and food handlers showed an epidemiological link between the cases and the food handler.

*S. typhimurium* is reported as one of the most common serotypes infecting humans.<sup>5</sup> Our findings were consistent with a large outbreak reported in Sydney in year 2011 which involved 154 cases positive for *S. typhimurium*, and was linked to consuming chicken salad roll at a restaurant.<sup>6</sup>

**Table 2. Results of a case-control study from people who consumed food at Night Market A in Kuala Terengganu District, Terengganu State, Malaysia, 28 Feb to 1 Mar 2014 (n=116)**

	Ate		Did not ate		Odds Ratio	95% CI
	Case	Control	Case	Control		
White Fried Rice	53	3	63	49	13.74	4.05-46.61
Red Fried Rice	30	8	86	44	1.92	0.81-4.54
Fried Mee	15	24	101	28	0.17	0.08-0.37
Fried Keow Teow	23	15	93	37	0.61	0.29-1.30

Nagelkerke  $R^2 = 0.405$ , Hosmer and Lemeshow Test = 0.967

**Table 3. Results of a case-control study from people who consumed food at Night Market B in Kuala Terengganu District, Terengganu State, Malaysia, 28 Feb to 1 Mar 2014 (n=55)**

	Ate		Did not ate		Odds Ratio	95% CI
	Case	Control	Case	Control		
White Fried Rice	24	6	31	70	9.03	3.36-24.3
Red Fried Rice	22	8	33	68	5.67	2.28-14.07
Fried Mee	9	30	46	46	0.30	0.13-0.70
Fried Keow Teow	4	17	51	59	0.27	0.09-0.86

Nagelkerke  $R^2 = 0.471$ , Hosmer and Lemeshow Test = 0.994





(a) Improper storage of the utensils



(b, c) Improper storage of raw foods in the refrigerator and temperature tested to be higher than the acceptable standard



(d) Chili paste container not sealed materials and utensils



(e) Dirty kitchen floor



(f) Water in the buckets for washing of raw and kept at room temperature

Figure 3. Photos of food preparation shop for selling food at two night markets in Kuala Terengganu District, Terengganu State, Malaysia, March 2014



Figure 4. Ready-to-eat fried noodle and rice (left) from the FS1 Kitchen at two night markets (middle and right) in Kuala Terengganu District, Terengganu State, Malaysia, March 2014

Salmonellosis outcomes differ substantially by serotypes. A study on invasive disease, *S. typhimurium* was significantly less invasive, compared to *S. enteritidis*, Heidelberg, Choleraesuis, and Dublin.<sup>7</sup> Case fatality rate in this outbreak was 0.6% which was consistent for non-typhoidal *Salmonella* infection reported elsewhere as less than 1%.<sup>7</sup> Although we detected *S. corvalli* from environmental samples, the serotype had been less frequently reported in humans, compared to the environment. In addition, this serotype was not discovered from human cases in this outbreak.

Ready-to-eat foods are commonly sold in the food markets of the developing countries as it is accessible and affordable for people in the community as well as tourists discovering the local food culture.<sup>2</sup> Raw

vegetables and ready-to-eat foods pose higher risk for bacterial contamination such as *Staphylococcus*<sup>8</sup>, *Salmonella*<sup>8,9</sup>, *Campylobacter*<sup>9</sup>, norovirus, and hepatitis A and E<sup>10</sup>. Hence, according to the World Health Organization, multidisciplinary approach in microbiology, food science, health promotion and sanitation management are essential to provide safe and nutritious foods in the markets.<sup>2</sup>

Multi-drug resistant *S. typhimurium* (phage type DT104) isolates had been reported from several countries.<sup>11</sup> However, in this outbreak, information on antibiotic treatment was not available, and phage typing and antibiotic sensitivity test specifically for these strains were not performed.

Although the interviews were conducted within one week of event, the information obtained from

personal interviews could not be verified and the food handlers' food handling practices were not observed. However, the environmental investigation supported the epidemiological findings. There was poor food handling practices in the kitchen as well as in the night market that might have allowed cross contamination. The stool samples from asymptomatic food handlers on duty during the event were positive for *S. typhimurium*, suggesting that contamination could have happened during the preparation of white fried rice.

Another limitation was no samples taken from controls. If there were asymptomatic cases among controls, the odds ratio would be underestimated.

### Action Taken and Recommendations

The FS1 kitchen was immediately closed for two weeks under the Ministry of Health Communicable Disease Act of 1988<sup>12</sup>. The two food handlers with *Salmonella* were barred from handling the foods until all three consecutive stool cultures were tested negative for *Salmonella* spp. The food premise operator was recommended to improve the cooking facilities, including fixing tile flooring for easy maintenance and storage of dried raw materials and utensils. Top loading refrigerator for raw materials and chiller for cooked foods were suggested. Food handlers were advised and educated in the hygienic preparation and serving of foods.

Reassessment of the kitchen was done after two weeks, and showed an improvement and its score increase to 83% (Figure 5). In total 18 night markets visited, 776 food premises were inspected of which 477 (61.5%) were scored grade A and 77 (19.9%) grade B. Grade A was given to food premise with the scoring of 80% and more, and grade B was 60 to 79% score. There was no proper documents on health examination and immunization card in 222 food premises (28.2%), and were compounded by the Local Authority.

Health education pamphlets on food safety, prevention of poisoning and how to choose safer food from night market were distributed to food handlers and public at night markets. A radio talk session was given via local radio station aimed to increase consumers' awareness on the food safety issues particularly ready to eat foods from night markets.

Health clinics in neighboring districts: Marang, Setiu and Hulu Terengganu were alerted on the second day of the outbreak. They were required to notify any acute gastroenteritis case related to consumption of foods from NMA and NMB.



**Figure 5. Improved situation after 2 weeks of closure of the food preparation shop for selling food at two night markets in Kuala Terengganu District, Terengganu State, Malaysia, March 2014**

The findings of this outbreak were presented to the Food Safety and Quality Unit Terengganu State Health Department and the following recommendations were suggested: strengthen the monitoring of night market food premises including home kitchens where the foods are prepared, institute effective health promotion and education strategies for night market food handlers and consumers, strengthen the enforcement of food safety law related to night markets, advocate local authority to enforce food premise licensing, and improve night markets infrastructures such as provision of safe water supply, and standard mobile stalls.

### Conclusions

This is a common source outbreak caused by *S. typhimurium* with case fatality rate of 0.6%. The most probable source of infection was the asymptomatic food handler who may have contaminated the white fried rice during food preparation. Possible contributing factors were unhygienic food handlers and food handling practices,

and poor sanitation and substandard kitchen infrastructure. The outbreak was controlled first by removing the source (infected food handler), educating to food vendors and consumers, and prompt outbreak management with multi-departments' involvement.

### Suggested Citation

Ab Karim B, Latip AL, Abd Shukor AS, A Rashid N, Wan Mohd WM, Kamaludin F. A large common source outbreak of *Salmonella typhimurium* linked to Kuala Terengganu night markets, Malaysia, 2014. OSIR. 2017 Jun;10(2):1-7.

### References

1. Luquero FJ, Banga CN, Remartínez D, Palma PP, Baron E, Grais RF. Cholera epidemic in Guinea-Bissau (2008): the importance of "place". PLoS One. 2011 May 4;6(5):e19005.
2. World Health Organization. A guide to health food markets. Geneva: World Health Organization; 2006 [cited 2017 Jan 6]. <[http://www.who.int/foodsafety/publications/capacity/healthymarket\\_guide.pdf](http://www.who.int/foodsafety/publications/capacity/healthymarket_guide.pdf)>.
3. United States Food and Drug Administration. Hazard analysis critical control point (HACCP). 2017 Mar 4 [cited 2017 May 16]. <<https://www.fda.gov/food/guidanceregulation/haccp/>>.
4. Heymann LD. Control of communicable diseases manual. 18th ed. Washington DC: American Public Health Association, 2004.
5. Majowicz SE, Musto J, Scallan E, Angulo FJ, Kirk M, O'Brien SJ, et al. The global burden of nontyphoidal *Salmonella* gastroenteritis. Clin Infect Dis. 2010 Mar 15;50(6):882-9.
6. Norton S, Huhtinen E, Conaty S, Hope K, Campbell B, Tegel M, et al. A large point-source outbreak of *Salmonella typhimurium* linked to chicken, pork and salad rolls from a Vietnamese bakery in Sydney. Western Pac Surveill Response J. 2012 Jun 21;3(2):16-23.
7. Jones TF, Ingram LA, Cieslak PR, Vugia DJ, Tobin-D'Angelo M, Hurd S, et al. Salmonellosis outcomes differ substantially by serotype. J Infect Dis. 2008 Jul 1;198(1):109-14.
8. Ananchaipattana C, Bari ML, Inatsu Y. Bacterial contamination into ready-to-eat foods sold in Middle Thailand. Biocontrol Sci. 2016;21(4):225-230.
9. Jørgensen F, Sadler-Reeves L, Shore J, Aird H, Elviss N, Fox A, et al. An assessment of the microbiological quality of lightly cooked food (including sous-vide) at the point of consumption in England. Epidemiol Infect. 2017 May;145(7):1500-1509. Epub 2017 Feb 27.
10. Terio V, Bottaro M, Pavoni E, Losio MN, Serraino A, Giacometti F, et al. Occurrence of hepatitis A and E and norovirus GI and GII in ready-to-eat vegetables in Italy. Int J Food Microbiol. 2017 May 16;249:61-65. Epub 2017 Mar 14.
11. Threlfall EJ. Epidemic *Salmonella typhimurium* DT 104- a truly international multiresistant clone. Journal of antimicrobial Chemotherapy, 2000;46:7-10.
12. Laws of Malaysia. Act 342: prevention and control of infectious diseases Act 1988. 1988 Sep 8 [cited 2017 Jan 4]. <[www.moh.gov.my/index.php/database\\_stores/attach\\_download/317/19](http://www.moh.gov.my/index.php/database_stores/attach_download/317/19)>.