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A Large-Scale *Vibrio parahaemolyticus* Food Poisoning Outbreak

Introduction

School lunches or boxed lunches, for their convenience, are a major source of lunches of school children in elementary and junior high schools and employees of enterprises. However, factories supplying school lunches or boxed lunches, often, for human errors in the handling, storing and transportation of food, may cause serious problems. Data published by the Bureau of Food Sanitation of the Department of Health[1] show that the most place where food poisoning outbreaks occurred in 1994 was schools, at a rate of 29.4% (30/102) with a total number of victims of 2,175 persons. A similar unfortunate incident occurred once again on 13 October 1995 in the Metropolitan Taipei Area at such a large scale unnoticed in the last 10 some years.

On 13 October (Friday), students and teachers of the Kuantu, Taoyuan, Wenhua and Mingtech elementary schools of Taipei City, Santzu, Tengkun and Wenhua elementary schools of Taipei County, and employees of Chiyih and Tehchung companies of Taipei County, after having had lunches supplied by a food factory, began, at 5 and 6 pm of that day, to develop symptoms such as diarrhea, stomachache and vomiting, and were taken to the Tamshuei Branch, Mackay Memorial Hospital, the First Hospital, the Kunghsiang Hospital and the Yumin Hospitals for treatment. The number of patients reached the highest at 3 and 4 am of next morning. A large-scale food poisoning outbreak was therefore suspected. The suspected incident occurred at the same time in seven elementary schools and some companies in Taipei City and County. All victims consumed the same lunches or boxed lunches supplied by the same food factory on 13 October. The food company supplied to the seven elementary schools lunches for 3,124 persons; of them, 1,706 developed symptoms; of them, 1,010 were treated at hospitals and clinics. Data of the Bureau of Food Sanitation of the Department of Health[1-5] show that this number far exceeded the average annual number of food poisoning victims in the last five years: 43 in 1990[2], 63 in 1991[3], 77 in 1992[4], 55 in 1993[5], and 73 in 1994[1]. Definition of "food poisoning" according to the "Manual for the Collection of Specimens for Food Poisoning" is: "... two or more persons who have taken the

same food and developed similar symptoms....". By this definition, the incident was decided to be a food poisoning outbreak of the same source of infection (school lunches or boxed lunches supplied on 13 October).

To understand the cause of the incident and to identify the pathogenic agent, an epidemiological investigation was conducted. The investigation focused on: visits to patients admitted in hospitals for treatment, survey of the sanitary conditions of the environment, the kitchen and the toilet of the food factory, investigating the menu of the lunch and the sources of food materials, and questionnaire interview of students and teachers on their intake of the lunch and symptoms. Health bureaus were also asked to collect specimens of human excreta for the laboratory testings by the National Institute of Preventive Medicine of the Department of Health, specimens of food residuals and environment for the laboratory testings of the National Laboratories of Food and Drugs of the Department of Health.

Materials and Methods

The cohort method[7] was applied in the present epidemiological investigation. It was first assumed that the victims of the incident (primarily school children) all had equal opportunity to be exposed to the school lunches. Based on this assumption, those who had a certain food item were grouped as "the exposed"; and those who did not, "the non-exposed". It was further assumed that the process of developing food poisoning due to the school lunch was a random process. That is, chances of developing food poisoning to each eater of certain contaminated food items were equal. Again, based on this assumption, those who had a certain food items and became ill were grouped as "the infected"; and those who ate the same food item but did not become ill, "the non-infected". Thus, for every food item, there could be a 2×2 "exposure-infection" table to calculate the "relative risk" of that particular food item. By the size of the relative risk and its statistical significance, food items suspected for the outbreak could be identified. Further verification by the symptoms of those infected and the laboratory findings, the pathogenic agent of the outbreak could be identified.

The investigation was thus conducted through following steps:

Visits to patients in hospital:

On 14 and 16 October, patients at the emergency department of the Tamshuei Branch, Mackay Memorial Hospital were visited to understand the food items they took, the process of becoming ill and the symptoms. Questions were also asked of the physicians as to the process of treatment and medical records of patients reviewed. Other reasons of sickness were also considered. The hospital laboratory was also contacted to learn about the findings of the laboratory testings of stools for reference in the identification of the pathogenic agent.

Survey of the sanitary conditions of the food factory:

On 14 October, a team visited the food factory located in Tamshuei to collect information concerning the menu of the school lunches and boxed lunches, sources of the raw materials and the process of handling and storing the food. The manager was also asked to demonstrate the process of preparing the food, and to explain the ways the food was kept warm and transported to schools. The sanitary conditions and temperature of the storerooms, the refrigerating rooms and the refrigerators, the sanitary conditions of the place where food was prepared and packed, and the toilet facilities were also surveyed. According to the information of the factory workers, the water used in the factory was the tap water. A name list of the workers on duty and their responsibilities, their health conditions on that day and records of the annual physical examinations, the number of lunches supplied and a list of the customers were also obtained. At the same time, staff of the 7th section of the Taipei County Health Bureau also collected on the spot specimens of ten kitchen utensils such as the ladle, knife and chopping board, and also specimens of the water supply in the kitchen. Four environmental specimens from the wood, plastic box, floor and iron bar of the vans that transported lunches were also collected.

Questionnaire interview:

A structured questionnaire for school children was designed based upon the discussions with the hospitalized patients and the doctors. The questionnaire included items such as: personal background information, time when school lunch or boxed lunch was consumed, food items consumed, any uncomfortable feelings, symptoms and time of onset, medical care and time to recovery. As the number of students infected was large, the Santzu Elementary School, out of the seven elementary schools where the outbreak occurred, was randomly selected for the questionnaire interview. The face-to-face questionnaire interview of 469 students (263 boys and 206 girls) of the 4th, 5th and 6th grades who had the lunch on 13 October was conducted on 16 October.

To understand which food items were contaminated, employees of the two companies were also interviewed with a questionnaire. With the exception of the contents of the menu, the questionnaire was similar to that for the school children. 11 and 13 questionnaires were collected from each of the companies.

Collection of specimens:

Rectal swab specimens of human excreta were collected from the infected students by the Taipei City Health Department and the Taipei County Health Bureau for the laboratory testings by the National Institute of Preventive Medicine. Tests were conducted for: *Vibrio parahaemolyticus, Bacillus cereus, Pathogenic E-coli, Staphylococcus aureus, Salmonella, Vibrio cholerae, Bacillus typhosus, Bacillus paratyphosus* and *Bacillus dysenteriae.*

Food residual specimens were collected from the food samples kept by the schools. They included: pork noodle with mushroom, deep-fried diced chicken, three shred vegetables (tree fungus, carrot and Szechuan cabbage), fried egg, meat ball soup and Chinese cabbage. Food specimens collected by the Taipei County Health Bureau were sent to the National Laboratories of Food and Drugs for laboratory testings; food specimens collected by the Taipei City Health Department were tested by the Laboratory of the Department. Tests were conducted for: *Vibrio parahaemolyticus, Bacillus cereus, Salmonella, Pathogenic E-coli, Staphylococcus aureus,* enterotoxin.

Environmental and utensil specimens were also collected from the factory for the laboratory testings by the National Laboratories of Food and Drugs. Tests were conducted for: *Staphylococcus aureus,* enterotoxin, *Vibrio parahaemolyticus, Salmonella, Pathogenic E-coli,* and *Bacillus cereus.*

Data processing and analysis:

Data collected through questionnaire interviews were stored with dBase PLUS software, then processed with SAS and Epi-Info to establish the validity of the database. Once the validity was established, data were described and analyzed item by item. The cross relations between items were tested by the multivariate analysis.

Symptoms expressed by infected students and hospitalized patients were used to define an "infected case". Incidence and the relative risk of a specific food item were then calculated. Both univariate and multivariate analyses were conducted primarily by χ^2-test. Finally, the statistical analyses and the test findings of human, food and environmental specimens were used to decide the likely pathogenic agent of the present incident.

Figures were produced by using the Microsoft Windows Word 6.0 and Excel 5.0. The computer used was the 486DX66 personal computer.

Results

Food preparation and sources of materials:

The school lunches responsible for the present incident were supplied by a certain food factory. It was assessed a Grade A boxed lunch/school lunch factory supplying food for long time primarily to schools and companies. School lunches were supplied to elementary schools; whereas boxed lunches were supplied to junior high schools and companies. Menu of school lunches supplied to elementary schools was fairly fixed and rotated on a schedule; menu for boxed lunches varied depending on food available for the day and the price. For instance, food items for elementary schools on 13 October included: pork noodle with mushroom, deep-fried diced chicken, three shred vegetables, fried egg, meat ball soup and Chinese cabbage; those for the boxed lunches for junior high schools included: chicken steak, fried egg with tomato, barbecued pork, spring

roll and vegetable; and those for the boxed lunches for the companies included: rice, chicken steak, fried egg, barbecued pork, meat ball soup and vegetable.

The factory is located in Tamshuei. Food materials are supplied by a delivery store on regular basis. The store buys food materials at a central market in Taipei City and delivers them to the factory each day at around 8 am. What is noticeable is that both raw and cooked food items are placed together in the delivery van. On that day, with the exception of the fried eggs which were bought elsewhere; the rest food items were prepared by the factory. Lunches and boxed lunches were delivered in temperature-controlled vans to customers at around 11:30 am. The food items and their sources of materials suspected for the outbreak are described in detail as follows.

To prepare pork noodle with mushroom, pork and mushroom are fried first and put aside. Noodle is then fried. Noodle, pork and mushroom are finally put together. The noodle is supplied by a small shop in the locality. The manager of the shop said that noodle should first be boiled and then cooled. The shop very seldom produces, sells or stores a large quantity of noodle. On this day, the food factory ordered noodle for 3,000 persons. For this, the noodle was specially produced and delivered. The manager believed that the noodle supplied by his shop was always fresh.

Chicken used in the deep-fried diced chicken and the tree fungus, carrot and Szechuan cabbage used in the three shred vegetables were bought from the central market. The sources of chicken, tree fungus and carrot were not traceable. The Szechuan cabbage was manufactured by a factory in Taoyuan. The process is: the cabbage is bought in large quantity from Yunlin; the cabbage is then steeped in a two-storied high container of salted water for several months. The factory has 10 containers; each container has a supply for three months. When matured, the cabbage is sliced manually, placed with water in plastic bags and sold in the market. Water in the container and plastic bag was underground water; its chloride residual was found to be zero. The pH value of the liquid in the containers was around 6.8; that of the water in the plastic bag was between 6.4 and 6.6. In the yard outside the factory, some 10 chickens were kept. A simple squat-type toilet without septic tank and hand-washing facilities was located nearby.

For short of labor on that day to attend to the need of a large number of students, the factory ordered 3,000 fried eggs elsewhere. The fried egg factory was a small family-type factory in an apartment near the central market. Both illumination and environmental sanitation were poor. Though toilet and hand-washing facilities were available, there was no water for hand-washing. The factory produced red-stewed eggs for sale in the market and also took orders. A machine for frying eggs required two persons to operate. One would crack the egg on the frying pan at one end; the frying pan was moved forward by the belt; the egg, after two or three minutes, was collected by another person at the other end. Work began at 3 am of that day to fry the 3,000 eggs. At 6 am, the eggs were delivered to the food factory. No products other than eggs were produced by this factory.

Hospital visits and questionnaire interview:

Upon visits to the patients in the Tamshuei Branch, Mackay Memorial Hospital, the following symptoms were noted: diarrhea, stomachache, nausea and vomiting. Some even developed high fever and chill. Most patients recovered in three to four days after the onset of symptoms. Questionnaire interview of students of the Santzu Elementary School showed that 78.9% (370/469) of them developed uncomfortable feelings after consuming the food on 13 October; 92.2% (341/370) had diarrhea; 91.1% (337/370) had stomachache; 55.4% (205/370) had vomiting; 50.0% (185/370) had dizziness; 35.4% (131/370) had fever; 32.7% (121/370) had nausea; and 25.1% (93/370) had chill. A case was thus defined as: "one who had the school lunch on 13 October and who had at least two (inclusive) episodes of diarrhea a day and at least two of the following symptoms: stomachache, vomiting, dizziness, fever, nausea and chill".

In the school interviewed, 262 met the requirements of a case, giving an attack rate of 55.9% (262/469). An epidemiological curve showing the time of onset of symptoms (Figure 1) was prepared based upon the complaints of the students. As shown in Figure 1, the time of onset ranged from 1 hour to 38 hours, with a median of 12 hours. That is, a half of the students developed symptoms within 12 hours; another half started to show symptoms after 12 hours. Two peaks appear on the curve. That is, many students developed symptoms either 7 or 13 hours after the intake of the lunch.

An "exposure-infection" table was established for each food item through univariate analysis. All students interviewed were grouped into "the infected" and "the non-infected" by the definition of a case. By the consumption or not of a certain food item, students were also grouped into "the exposed" and "the non-exposed". From these tables, the relative risks and their corresponding 95% confidence intervals (see Table 1) were calculated. From Table 1, it was noted that pork noodle, diced chicken and meat ball soup were not statistically related to the food poisoning (p values all larger than 0.05); the three shred vegetables and the fried egg each was statistically related to the food poisoning (p values smaller than 0.05 and 0.01, individually). The relative risk of becoming ill by eating the three vegetables was 1.26 times higher than not eating; the 95% confidence interval was 1.07 times higher at the lowest level and 1.49 times higher at the highest level. The relative risk of becoming ill by having the fried egg was 1.72 times higher than not having; the 95% confidence interval ranged from 1.35 to 2.20 times. Statistically speaking, chances of becoming ill by having the fried egg were higher than by having the three vegetables.

Food items of statistical significance, the three vegetables and the fried egg, were then treated by multivariate analysis (see Table 1). Chances of becoming ill by having either or both food items were 2.34 times higher than having none of them. The difference was statistically significant at $p < 0.01$. Chances of becoming ill by having both food items were 2.47 times higher than having none of them. The difference was also statistically significant at $p < 0.01$. The chances were naturally higher than having the three vegetable alone (1.26) or the fried egg alone (1.72).

Figure 1. Epidemiological Curve of the Food Poisoning Outbreak, Santzu Elementary School

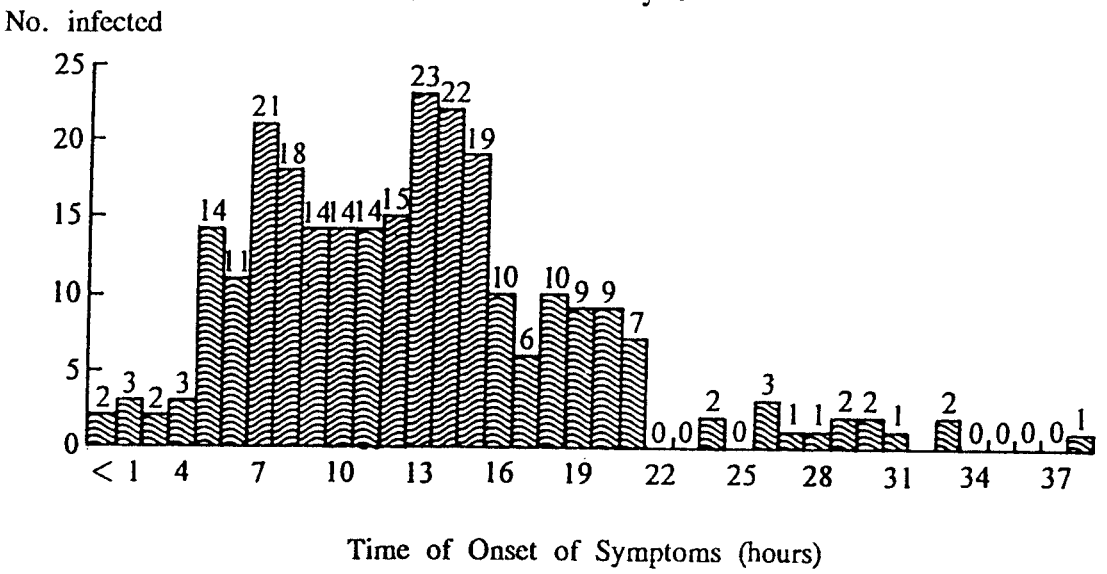

Table 1. Relative Odd Ratios and 95% Confidence Intervals by Single or Multiple Food Items

Food Item	Eaten	Food Poison Yes No. (%)	Food Poison No No. (%)	RR	95% CI
Pork noodle	Yes	259(98.9)	196(94.7)	2.66	(0.97-7.27)
	No	3(1.1)	11(5.3)		
Diced chicken	Yes	243(92.8)	192(92.8)	1.00	(0.73-1.36)
	No	19(7.2)	15(7.2)		
Vegetables	Yes	147(56.1)	89(43.0)	1.26	(1.07-1.49)*
	No	115(43.9)	118(57.0)		
Fried egg	Yes	216(82.4)	127(61.4)	1.72	(1.35-2.20)**
	No	46(17.6)	80(38.6)		
Soup	Yes	244(93.1)	184(88.9)	1.30	(0.91-1.85)
	No	18(6.9)	23(11.1)		
Vegetable or fried egg#	Yes	242(92.4)	151(73.0)	2.34	(1.59-3.44)**
	No	20(7.6)	56(27.0)		
Vegetable and fried egg@	Yes	121(92.4)	65(73.0)	2.47	(1.67-3.65)**
	No	20(7.6)	56(27.0)		

comparing having either the three vegetables or the fried egg with having none of them;

@ comparing having both the three vegetables and the fried egg with having none of them;

* statistically significant, $p < 0.05$, χ^2-test

** statistically significant, $p < 0.01$, χ^2-test

Of the 24 company employees (19 males and 5 females) interviewed, 22 developed uncomfortable feelings such as diarrhea. Other symptoms were: stomachache (77.3%, 17/22), vomiting, fever and chill (each 50.0%, 11/22), dizziness (45.5%, 10/22) and nausea (8.2%, 4/22). Symptoms appeared at 3 to 32 hours after the lunch, with most at 13 hours.

64% (7/11) of those interviewed in the Chiyih Company met the criteria of a case. Having any of the three food items, the pork noodle, the barbecued pork, or the vegetables, gave an attack rate of 64% (7/11). Having either the chicken steak or the three shred vegetables gave an attack rate of 70% (7/10). Having the fried egg gave an attack rate of 60% (6/10). In the Tehchung Company, 77% (10/13) of those interviewed met the criteria of a case. Having any of the three, the fried egg, the barbecued pork or the meat ball soup, gave an attack rate of 77% (10/13). Having the chicken steak gave an attack rate of 82% (9/11). Having either the rice or the vegetable gave an attack rate of 75% (9/12). The number of questionnaires collected from the companies was not large enough for further statistical analysis.

Findings of laboratory testings:

187 rectal swab specimens collected by the Taipei County Health Bureau from the patients were received by the National Institute of Preventive Medicine on 14 October. In 77 of them, *Vibrio parahaemolyticus* K12 was identified. In 4 of the 77, both *Vibrio parahaemolyticus* K12 and *Staphylococcus aureus* (one each of enterotoxin type A and type B producing and two of enterotoxin type C producing) were identified. In 4 others, *Staphylococcus aureus* (two each of enterotoxin type A and type C producing) was identified.

As only the Santzu Elementary School of Taipei County was selected for study, only the findings of the laboratory testings of the National Laboratories of Food and Drugs on the food residuals collected from this school are presented (Table 2). In the pork noodle, *Vibrio parahaemolyticus* type O10 and non-enterotoxin *Staphylococcus aureus* were isolated. In the chicken steak, three shred vegetables and fried egg, *Bacillus cereus, Vibrio parahaemolyticus* type O10 and non-enterotoxin Staphylococcus aureus were isolated. No *Salmonella, Pathogenic E-coli* and *Staphylococcus aureus* enterotoxin were isolated from these food specimens. No pathogenic agent was found in the ten utensil and four environmental specimens.

In 32 stool specimens of the hospitalized patients, *Vibrio parahaemolyticus* was isolated from 8 of them by the Laboratory of the Mckay Tamshuei Branch Hospital.

Discussion

Both the elementary schools and the junior high schools ordered school lunch/boxed lunch from the same food factory, and yet none of the junior high school students became ill. The school lunches ordered by the elementary schools and the boxed

Table 2. Laboratory Testings of Food Residuals

Specimen	*V. parahaemolyticus* (CFU/gm)	*B. cereus* (CFU/gm)	*S. aureus* (CFU/gm)	*Salmonela*	*E-coli*	*S. aureus* enterotoxin
Noodle	positive $< 1.0\times10^2$	negative	positive/ not isolated $< 1.3\times10^2$	negative	negative	not isolated
Chicken	positive $< 1.0\times10^2$	positive $< 9.5\times10^4$	positive/ not isolated $< 4.2\times10^3$	negative	negative	not isolated
Vegetable	positive $< 1.0\times10^3$	positive $< 3.5\times10^4$	positive/ not isolated $< 2.7\times10^3$	negative	negative	not isolated
Egg	positive $< 1.5\times10^3$	positive $< 1.4\times10^5$	positive/ not isolated $< 4.2\times10^4$	negative	negative	not isolated

lunches ordered by the two companies seemed to have some problems. When menus of these lunches and boxed lunches were compared, some differences were noted. Some employees of the Tehchung Company who had boxed lunches containing no three shred vegetables were infected; those who had either school lunches or boxed lunches containing fried eggs were also infected. No junior high school students were infected as their boxed lunches contained no fried eggs but egg fried with tomato. The fried egg with tomato was prepared by the food factory; whereas the fried eggs were bought elsewhere. Of those employees of the two companies who had the fried eggs, 72.7% (16/22) became ill. It thus seemed that the three shred vegetables were not related to the incident but that the fried eggs were the most likely cause of the outbreak.

Though *Vibrio parahaemolyticus, Bacillus cereus, Staphylococcus aureus* and other pathogens were isolated from the food left-overs and human specimens, in the food residual and patient specimens. primarily *Vibrio parahaemolyticus* and *Bacillus cereus* were isolated. Generally speaking, the major symptom of the vomiting type poisoning by *Bacillus cereus* is vomiting, and the incubation period being one to 8 hours; whereas the major symptom of the diarrhea type poisoning by *Bacillus cereus* is watery diarrhea, and the incubation period being 6 to 24 hours[8,9]. Though the amount of *Bacillus cereus* in the food residual specimens, $> 10^5$ CFU/gm[9], was sufficient to cause infection, either the symptoms or the incubation period of the present outbreak did

not correspond with the usual symptoms or incubation periods of any infections by *Bacillus cereus*. The *Staphylococcus aureus* isolated from the food residual specimens was not capable to produce any enterotoxin; while the number of *Staphylococcus aureus* capable of producing enterotoxin isolated from human specimens was too small (8 out of 187 specimens). In addition, diseases induced by the enterotoxin produced by *Staphylococcus aureus* often develop vomiting but rarely diarrhea[8,9], and symptoms often appear 30 minutes to 8 hours after food intake. Again, they were different from the present outbreak. Thus, it was concluded that the present outbreak was of the infection type rather than the intoxication type; and that it was not related to either *Bacillus cereus* or *Staphylococcus aureus*.

The incubation period of *Vibrio parahaemolyticus* infections varies by the amount of pathogens. It is often between 12 and 24 hours[8], though it can be as short as 4 hours and as long as 96 hours. The illness often lasts on average for two days (between one and five days). Diarrhea and stomachache are the early symptoms[10,11], and most patients will have both symptoms. Diarrhea is sudden and watery, sometimes with blood. Some will also develop other symptoms such as vomiting, nausea, fever, chill and dizziness. Fatality is low. The epidemiological curve of the present outbreak (Figure 1) shows that most patients became ill 5 to 21 hours after lunch, and that the major symptoms were diarrhea and stomachache with some developing dizziness, vomiting, fever and chill as well. They recovered in two to three days. These findings corresponded with the special features of *Vibrio parahaemolyticus* infections mentioned above. Furthermore, *Vibrio parahaemolyticus* was isolated from the food residual and human specimens, though their serotypes varied by the different methods of laboratory testings. It was therefore concluded that the pathogenic agent of the present food poisoning outbreak was *Vibrio parahaemolyticus*.

Vibrio parahaemolyticus is one of the major pathogens of bacterial gastroenteritis, causing infections more often in warm months[11,12]. It is a common pathogenic agent of food poisoning in coastal countries such as Taiwan, Japan, the Southeast Asian countries, the United Kingdom, the Netherlands and the United States[11,13-16]. *Vibrio parahaemolyticus* is gram-negative, grows under an optimal temperature of 35° to 37°C, though can also survive under 10° to 44°C. Growth is inhibited in pH values lower than 5.0 and higher than 11.0. It lives in shellfishes and fishes in the ocean[17]. Under optimal conditions, it doubles in number within 12 to 18 minutes[18]. The number of colonies on the surface of a just-caught fish is 10^2 CFU/gm; it increases to 10^3 to 10^4 CFU/gm at the time the fish reaches the market; and in three to four hours, the colony number reaches to a poisonous amount of 10^5 to 10^7 CFU/gm. Poisoning is often brought about by the contaminated food containers. Food that is not sufficiently frozen, contaminated, sea food not fully cooked or eaten raw, or food not properly stored after cooking can also cause poisoning. Wachsmuth[19] and Joseph[20] reported cases of *Vibrio parahaemolyticus* infections indirectly through contaminated media such as hands, rags, kitchen utensils, chopping board, knives and other containers.

The fried eggs suspected of the present outbreak were bought by the food factory elsewhere. The fried egg factory fried eggs on a semi-automatic machine. The factory produced no other food than fried or red-stewed eggs. Generally, *Vibrio parahaemolyticus*

dies within several minutes under heat treatment at 80°C and above. From the manufacturing process, contamination by *Vibrio parahaemolyticus* was unlikely to take place in the fried egg factory. The process began at 3 am till 6 am; the eggs were delivered to the food factory at 8 am. The van that carried the eggs also carried other fresh food. The manager of the delivery refused to tell whether sea food was also carried in the van. The fried eggs could have been contaminated on the way to the food factory. The eggs were then delivered to schools at 11:30 am. The entire process between the time the eggs were fried and the time they were consumed took six to seven hours. It was not clear whether the eggs were kept too long in the food factory or whether they were contaminated by *Vibrio parahaemolyticus* in the factory. The menus of the food factory showed that the menu of the day and that of three days before did not contain any sea food. In short, the fried eggs were the only food item bought elsewhere. They were found to be related to the food poisoning. Their contamination by *Vibrio parahaemolyticus* seemed to be the reason of this outbreak.

Recommendations

Upon the investigation of this "record-breaking" outbreak of food poisoning, some recommendations are hereby made hoping that future incidents can be avoided.

1. competent authorities on food sanitation at various levels should strengthen the control of food establishments by:

   — advocating the concept of food sanitation and safety; encouraging food industries to establish systems to control the incoming food materials;

   — helping food factory managers realize their maximum level of productivity; encouraging them to produce within their own productivity; discouraging them from taking excess orders to assure the quality and sanitation of products.

2. an inter-ministerial committee be set up by the Industrial Development Bureau of the Ministry of Economic Affairs, the Council for Agriculture Development and the Department of Health to enforce a licensure system such as GMP and CAS for boxed lunch manufacturers to verify the quality of their products. The Industrial Development Bureau will provide boxed lunch manufacturers with necessary counseling and service; agriculture authorities should strengthen the sale and transportation of products and the development of food processing technology, and at the same time, offer incentives to the manufacturers to reduce their financial burden in having their products verified. The Department of Health will be responsible for the assessment and enforcement of the licensure system.

3. the quantity of boxed lunches to be manufactured and the size of staff should be regulated by the grade of the manufacturers; the storage, safe-keeping and transportation of raw and cooked food products should be regulated.

4. boxed lunch industries are moving toward more organized business management,

the concept of "all as a common body sharing the same destiny" should be advocated; that is, health education for food sanitation should equally be given by health authorities to the managers and food handlers of boxed lunch manufacturers and to their relevant suppliers, deliveries and food factory workers as well.

5. food handlers, particularly cooks, can only be permitted to practice after training and assessment in food sanitation.

6. the public should be educated through mass media on the four principles in the prevention of food poisoning:

   — cleanness: keep food, utensils, refrigerators and body clean;

   — swift: cook and process fresh materials swiftly; eat them soon after processing; handle the left-overs quickly;

   — heating: food should be heated before eating; the temperature of the central part should be maintained at 65°C for more than 15 minutes;

   — freezing/cold storing: when necessary, food should be kept in refrigerator; for freezing, the temperature should be kept at −18°C and below; for cold storing, the temperature should be lower than 4°C.

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