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An Epidemiological Investigation of a Food-Poisoning Outbreak in a Township in Taichung County

1. Introduction

Outdoor cooking, by either individually-employed cooks or restaurants, provides an inexpensive and lively occasion much enjoyed by the public. However, most of the food providers involved do not have definite business sites. Thus, their control is difficult and, unfortunately, they are often a major cause of food-poisoning outbreaks. The "Report of Food Poisoning Outbreaks" based on statistics issued by the Department of Health shows that, among all food poisoning outbreaks in the year 1994, outdoor cooking was a serious cause, following only those restaurant sites where either contamination of foods or faults in food processing were identified. Outdoor cooking accounted for 9 outbreaks and 269 victims. Food preparation where both cooking and sanitary facilities are below standard poses many sanitary control problems. Epidemiological investigations are aimed at identifying causes of food-poisoning for the prevention and control of the resulting food-poisoning outbreaks.

2. The Background

On the evening of 30 August 1995, an outdoor wedding party of 56 tables for around 400 guests was held by a Lee Family, residents of a Taichung County township. The foods were prepared outdoors by a Houli Township cook. At around 22:00 o'clock of the same evening, some of the guests began to develop symptoms of suspected food poisoning as vomiting and diarrhea. Some visited the local Health Station for medication on 31 August. A staff member of the health station, also one of the guests, became sick. The County Health Bureau, upon notification from the Township health station on 31 August, began an investigation in the afternoon of the same day. As guests were by then fairly widely dispersed, making the investigation difficult, the Bureau requested help from the Field Epidemiology Training Program (FETP), the National Institute of Preventive Medicine and the Department of Health. An FETP group was dispatched on 1 September to conduct an epidemiological investigation on the spot.

3. Materials and Methods

A. The Subjects:

Guests of the party had come from many different areas. Based upon the list supplied by the hosts, 135 guests were identified and 125 of those were telephone-interviewed, at a coverage rate of 92.59%. Of those interviewed, 9 had eaten no food at the party, but 116 had.

B. Method of Investigation:

A structured questionnaire was used for the telephone-interview. The questionnaire included items such as personal background information; presence at the wedding party; identity of foods consumed, with time eaten; any discomfort suffered with time of onset and symptoms; medication, if any; and time of recovery. Data thus collected were processed with Epi-Info and SAS for statistical analysis.

C. Definition of a Case:

A case was defined as one who had eaten food at the Lee wedding dinner party at 19:00 hours on 30 August 1995 and who had subsequently developed (1) diarrhea or vomiting; plus any one of the following: (2) nausea, fever, headache, abdominal pain.

D. Laboratory Testing:

1. Food Specimens:

One specimen of mixed food left-overs (already decayed) was collected on 1 September for laboratory tests by the Central Branch Laboratory of National Laboratories of Foods and Drugs of the Department of Health for *Staphylococcus aureus*, enterotoxin of *Staphylococcus aureus*, *Vibrio parahaemolyticus*, *Salmonella*, pathogenic *Escherichi coli*, and *Bacillus cereus*.

2. Human Specimens:

Seventeen rectal swab specimens were collected by the Health Station on 31 August. On 2 September, one rectal swab and one nasal-pharyngeal swab specimen were collected from the cook and his wife, and one stool and one blood specimen from a patient with fever. On 2 September, the Chingshuei Health Station collected another three rectal swab specimens from patients. A total of 22 rectal swabs, 1 stool, 1 blood and 2 nasal-pharyngeal swab specimens were collected from 23 individuals for laboratory testing by the Central Branch Laboratory of the National Institute of Preventive Medicine, of the Department of Health for *Vibrio parahaemolyticus*, *Vibrio cholerae*, Bacillus typhoid, Bacillus paracolon, *Salmonella*, *Bacillus dysenteriae*, *Staphylococcus aureus*, and *Bacillus cereus*.

3. Environmental Specimens:

On 4 September, a specimen of the drinking water collected from the Lee home was sent to the Central Branch Laboratory of National Laboratories of Foods and Drugs of the Department of Health for testing for *Staphylococcus aureus*, enterotoxin of *Staphylococcus aureus, Vibrio parahaemolyticus, Salmonella*, pathogenic *Escherichi coli* and *Bacillus cereus*.

4. Results

A. Distribution of Cases:

Of the 116 guests who had taken wedding dinner foods, 75 met the criteria for a case, giving an attack rate of 64.66%. Of the 76 males, 44 became sick, or an attack rate of 57.95%; of the 40 females, 31 became sick, with an attack rate of 77.50%. Victims had become sick in from 4 to 36 hours after the meal, though most had fallen ill in a range of from 5 to 10 hours range. The epidemiological curve is shown in Figure 1. The median incubation period was nine hours. Symptoms were: diarrhea (100%), abdominal pain (92.2%), vomiting (56.0%), fever (41.3%) and nausea (30.7%). Most patients recovered in three days.

B. x^2-Test:

Of the 125 guests telephone-interviewed, 9 did not attend the party, nor were they sick; 116 had eaten food there, and 75 became sick. x^2-test was performed on each of the food items to identify any associated with the poisoning, with findings as shown in Table 1. Statistically, food items such as deep-fried prawn, mullet eggs, abalone, steamed garoupa, nine-hole clams with garlic and lobster cooked-in-two-ways were found to be associated with the poisoning ($p < 0.05$). The odds ratios of those who had deep-fried prawns, mullet eggs, abalone, steamed garoupa, clams and lobsters were 1.51, 1.41, 1.31, 1.47, 1.39 and 1.43 times more, respectively, than for those guests who had not eaten them.

C. Multivariate Analysis:

Many had eaten not just one, but more than one, food item. A multivariate analysis was thus performed on various food items. The more food items consumed, the higher the odds ratios were (Table 2 to 5).

D. Laboratory Findings:

1. Food Specimens:

Bacillus cereus of more than 1.5x106 CFU/gm was isolated from the mixed left-over food collected on 1 September.

2. Human Specimens:

Vibrio parahaemoloyticus of Serotype K58 was isolated from 12 of the 22 rectal swab specimens. No pathogens were isolated from the one blood, one stool and two nasal-pharyngeal specimens.

3. Environmental Specimens

No pathogens were isolated from the one water specimen collected from the Lee's on 4 September.

5. Discussion

The fact that 9 guests who had not eaten the food served were not sick, and that 75 of the 116 who did eat the food and became sick, suggested that the poisoning was associated with the wedding party foods. The findings of the epidemiological investigation were that the incubation period ranged from 4 to 36 hours with a median of 9 hours; that prawns, mullet eggs, abalone, garoupa, clams and lobsters were associated with the poisoning; and that the odds ratios increased with the number of food items consumed, indicating that these food items were associated with the poisoning. Of the four cold appetizer dishes (sashimi, deep-fried prawns, mullet eggs and abalone), the sashimi was supplied in boxes by a sea-food store. The other three, processed by the cook himself, were those found to be associated with the poisoning. The fact that *Vibrio parahaemolyticus* of the same Serotype K58 was isolated in 12 of the 22 rectal swab specimens further indicated that the present incident was caused by sea food contaminated by *Vibrio parahaemolyticus* of Serotype K58. Understandably no *Vibrio parahaemolyticus* was isolated from the food specimens already decayed.

Vibrio parahaemolyticus is a common pathogen of food-borne gastroenteritis with significant seasonal variations. Infection occurs more often in warm season in Taiwan, Japan, southeast Asian countries and the United States. As Japanese are fond of raw sea foods and shell fish, reports are that more than 60% of the food-borne poisonings in Japan are due to *Vibrio parahaemolyticus*. Between 1981 and 1994 in Taiwan, of the 1,039 reported food poisoning incidents with 564 known pathogenic agents, 506 were caused by bacteria. Of those, 236, or 46.64%, were caused by Vibrio parahaemolyticus[2].

Vibrio parahaemolyticus is a short, gram-negative, aerobic and salt-loving bacillus which often grows in the water at about 37 degrees along the sea shore in spring and summer, the bacillus lives on shell fish; in winter, it floats with sea water sediment, floating again and again to the surface as part of a cycle.[3] Under optimal conditions (30-37°C), *Vibrio parahaemolyticus* can double its number in 12 to 18 minutes. If the number of colonies on a freshly caught sea product is 102/gm, it increases to 103-104/gm by the time the fish reaches the market. The bacillus becomes pathogenic if the number of colonies is larger than 105/gm[4]. Foods not properly frozen, sea foods eaten raw or not sufficiently cooked, food contaminated by sea water and foods not properly stored after cooking may induce this kind of disease of the gastrointestinal system.

A serious epidemic of gastroenteritis occurred in Osaka, Japan, in 1950. It was not until 1953 that Fujino et al. isolated *Vibrio parahaemolyticus* from cooked sardines. The pathogenic agent was given that name by Sakazaki et al. in 1963[5-7]. By antigens, the pathogenic agent can be classified into 13 O antigen groups and 65 K sub-groups. Pathogenicity is considered to be related to beta-Hemolysis. This is known as "the Kanagawa phenomenon" (hemolyzation on Wagatsuma agar)[8].

The incubation period is, on average, from 15 to 17 hours (ranging from 2 to 48 hours), depending on the amount of bacilli taken. The illness generally lasts for two days (from one to five days). Symptoms are similar to those of salmonellosis and shigellosis: more than 95% of the patients have diarrhea and abdominal pain in the early stages[9-10]. Diarrhea is often sudden and watery, and may commonly occur as many as 15 times a day is not uncommon. Other symptoms such as prostration fever, chill, headache, nausea, vomiting and dehydration also occur. Deaths are relatively uncommon[11].

The cook involved concerned in this incident was found, after investigation, to be unlicensed. Soon after this occurrence, his establishment was closed by the Health Bureau. Raw materials for the foods served on that day had been ordered by the cook from a sea food store in Fengyuan City. They had been delivered to his house at around 08:30 hours on 30 August and forwarded to the wedding party site for processing in the afternoon. It was a hot day, and the sea food had not been properly frozen. *Vibrio parahaemolyticus* could have easily multiplied to an amount large enough to induce poisoning. The inadequate handling of food by the cook — handling raw and cooked foods at the same time or interchangeably, the mixed use of chop board, knives and dish cloths — could have caused cross-contamination of foods. *Vibrio parahaemolyticus* is heat-labile. Food that is not well-cooked or stored under low temperature can easily bring about poisoning.

6. Recommendations

A. Primary health workers professional knowledge of infectious diseases should be improved.

Through the present investigation it was found that the primary health care workers were unable to adequately cope with diagnosis, treatment and preventive measures — all important in instances of food poisoning outbreak. We therefore suggest that the professional knowledge of primary health care workers in this area be improved through on job training and regular seminars on infectious diseases. Primary health care workers should also be required, and encouraged through incentives, to report any outbreaks of this nature immediately to health authorities for management.

B. The functions of the National Committee on Food-borne Poisoning should be clearly defined.

Food poisoning outbreaks are relatively frequent in Taiwan. If the functions of local food-poisoning task groups are strengthened, the handling of food-poisoning outbreaks can be more prompt and effective. We therefore urge that an information network on food-poisoning be established between FETP and local health stations and public hospitals; and that members of the Nosocomial Infection Control Committees of all hospitals receive regular training, available through the FETP, in the prevention and control of acute food-poisoning. Those Committee members of local food-poisoning task groups should join Department of Health efforts to investigate food poisoning outbreaks.

C. The public itself should be better educated about on food sanitation and good food habits through the mass media. They should be told of possible results and warned against eating cold dishes and raw foods customarily served by outdoor cooks.

D. Control of outdoor cooking should be enforced through legislation.

Health bureaus should conduct regular physical examinations of cooks in the outdoor cooking business, and regular inspections should be made of facilities used for outdoor cooking. Outdoor cooking workers should be registered to ensure better supervision and management. Regular courses in food sanitation should be offered to them, with attendance required. Most foods suspected of inducing food poisoning are pre-processed. Cooks should be required to set up a system to register the sources of foods for follow-up.

E. The health of the public should be protected further through legislation.

In case of food-poisoning, cooks concerned should be fined and their licenses revoked according to the guidelines for the management of food poisoning incidents and also Article 11 of the Law for the Control of Food Sanitation. Above regulations stipulate that any violators can be sentenced to a maximum of three years detention and a fine of NT$10,000-40,000, with their business permits revoked.

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Table 1. Sickness by Food Items (N=116)

Food Item	Eaten			Not Eaten			Relative Risk (RR)	95% Confidence Interval	P-Value
	Sick	Not Sick	Attack Rate (%)	Sick	Not Sick	Attack Rate (%)			
Sashimi	29	15	65.90	46	26	63.90	1.03	0.78<RR<1.36	0.825
Deep-fried prawn	47	14	77.00	28	27	50.90	1.51	1.13<RR<2.03	0.003*
Mullet eggs	42	13	76.40	33	28	54.10	1.41	1.07<RR<1.86	0.012*
Abalone	42	13	73.30	31	25	55.40	1.32	1.00<RR<1.75	0.043*
Bird's nest and shark's fin	52	21	71.20	23	20	53.50	1.33	0.97<RR<1.82	0.053
Steamed garoupa	59	24	71.10	16	17	48.50	1.47	1.01<RR<2.14	0.022*
Crab on rice	50	24	67.60	25	17	59.50	1.14	0.85<RR<1.52	0.384
Clam in garlic	43	1-	75 40	32	27	54.20	1.39	1.05<RR<1.84	0.017*
Braised mutton	39	18	68.40	36	23	61.00	1.12	0.86<RR<1.47	0.404
Lobster	52	19	73.20	23	22	51.10	1.43	1.04<RR<1.97	0.015*
Fried sea cucumber	33	13	71.70	42	28	60.00	1.20	0.92<RR<1.56	0.196
Chicken leg	22	8	73.30	53	33	61.60	1.19	0.91<RR<1.56	0.248
Cake	11	8	57.90	64	33	66.00	0.88	0.58<RR<1.32	0.681
Ice	29	12	70 70	46	29	61.30	1.15	0 88<RR<1.51	0.311
Dessert	25	8	75 80	50	33	60.20	1.26	0 97<RR<1 63	0 115

* Significantly related

Table 2. Cross Analysis of Sickness by Two Food Items (N=116)

Food Item	Eaten			Not Eaten			Relative Risk (RR)
	Sick	Not Sick	Attack Rate (%)	Sick	Not Sick	Attack Rate (%)	
Prawn, mullet eggs	54	18	75 00	21	23	47.73	1.57
Prawn, abalone	59	21	73.75	16	20	44.44	1.66
Prawn, garoupa	66	25	72.53	9	16	36.00	2.02
Prawn, clam	54	19	73.97	21	22	48.84	1.52
Prawan, lobster	58	22	72.50	17	19	47.22	1.54
Mullet eggs, abalone	55	18	75.34	20	23	46.51	1.62
Mullet eggs, garoupa	64	25	71.91	11	16	40.74	1.76
Mullet eggs, clam	55	19	74.32	20	22	47.62	1.56
Mullet eggs, lobster	58	22	72.50	17	19	47.22	1.54
Abalone, garoupa	62	25	71.26	13	16	44.83	1.59
Abalone, clam	58	21	73.42	17	20	45.95	1.60
Abalone, lobster	62	23	72.94	13	18	41.94	1.74
Garoupa, clam	64	25	71.91	11	16	40.74	1.77
Garoupa, lobster	67	28	70.53	8	13	38.10	1.85
Clam, lobster	69	22	72.84	16	19	45.71	1.59

Table 3. Cross Analysis of Sickness by Three Food Items (N=116)

Food Item	Eaten			Not Eaten			Relative Risk (RR)
	Sick	Not Sick	Attack Rate (%)	Sick	Not Sick	Attack Rate (%)	
Prawn, mullet eggs and abalone	64	22	74.42	11	19	36.67	2.03
Prawn, mullet eggs and groupa	67	26	72.04	8	15	34.78	2.07
Prawn, mullet eggs and clam	59	22	72.84	16	19	45.71	1.59
Prawn, mullet eggs and lobster	61	25	70.93	14	16	46.67	1.52
Prawn, abalone and garoupa	67	26	72.04	8	15	34.78	2.07
Prawn, abalone and clam	64	24	85.33	11	17	39.29	1.85
Prawn, abalone and lobster	66	26	71.74	9	15	37.50	1.91
Prawn, garoupa and clam	67	26	72.04	8	15	34.78	2.07
Prawn, garoupa and lobster	70	29	70.71	5	12	29.41	2.40
Prawn, clam and lobster	61	24	71.76	14	17	45.16	1.59
Mullet eggs, abalone and garoupa	65	26	71.43	10	15	40.00	1.79
Mullet eggs, abalone and clam	64	23	73.56	11	18	37.93	1.94
Mullet eggs, abalone and lobster	64	23	73.56	11	18	37.93	1.94
Mullet eggs, garoupa and clam	66	26	71.74	9	15	37.50	1.91
Mullet eggs, garoupa and lobster	69	28	71.13	6	13	31.58	2.25
Mullet eggs, clam and lobster	63	24	72.41	12	17	41.38	1.75
Abalone, garoupa and clam	65	26	71.43	10	15	40.00	1.79
Abalone, garoupa and lobster	67	28	70.53	8	13	38.10	1.85
Abalone, clam and lobster	67	25	72.83	8	16	33.33	2.19
Garoupa, clam and lobster	69	28	71 13	6	13	31.58	2.25

Table 4. Cross Analysis of Sickness by Four Food Items (N=116)

Food Item	Eaten			Not Eaten			Relative Risk (RR)
	Sick	Not Sick	Attack Rate (%)	Sick	Not Sick	Attack Rate (%)	
Prawn, mullet eggs abalone and garoupa	68	27	71.58	7	14	33.33	2.15
Prawan, mulllet eggs, abalone and clam	67	25	72.83	8	16	33.33	2.19
Prawn, mullet eggs, abalone and lobster	67	26	72.04	8	15	34.78	2.07
Prawn, mullet eggs, garoupa and clam	68	27	71.58	7	14	25.00	2.15
Prawn, mullet eggs, garoupa and lobster	71	29	71.00	4	12	25.00	2.84
Prawn, mullet eggs, clam and lobster	64	26	71.11	11	15	42.31	1.68
Prawn, abalone, garoupa and clam	68	27	71.58	7	14	33.33	2.15
Prawn, abalone, garoupa and lobster	70	29	70.71	5	12	29.41	2.40
Prawn, abalone, clam and lobster	68	27	71.58	7	14	33.33	2.15
Prawn, garoupa, clam and lobster	70	29	70.71	5	12	29.41	2.40
Mullet eggs, abalone, garoupa and clam	67	27	71.28	8	14	36.36	1.96
Mullet eggs, abalone, garoupa and lobster	69	28	71.13	6	13	31.58	2.25
Mullet eggs, garoupa, clam and lobster	70	28	71.43	5	13	27.78	2.57
Abalone, garoupa, clam and lobster	69	28	71.13	6	13	31.58	2.25

Table 5. Cross Analysis of Sickness by Five and Six Food Items (N=116)

Food Item	Eaten			Not Eaten			Relative Risk (RR)
	Sick	Not Sick	Attack Rate (%)	Sick	Not Sick	Attack Rate (%)	
Prawn, mullet eggs abalone, garoupa and clam	69	28	71.13	6	13	31.58	2.25
Prawn, mullet eggs, abalone, garoupa, lobster	71	29	71.00	4	12	25.00	2.84
Prawn, mullet eggs, abalone, clam and lobster	69	27	71.87	6	14	30.00	2.40
Prawn, abalone, garoupa, clam and lobster	70	29	71.71	5	12	29.41	2.40
Mullet eggs, abalone, garoupa, clam and lobster	70	28	71.43	5	13	27.78	2.57
Prawn, mullet eggs, garoupa, abalone, clam and lobster	71	29	71.00	4	12	25.00	2.84

Figure 1. Epidemic Curve of a Food Poisoning Out Break (N=74)