

A campylobacter outbreak associated with stir-fried food

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SUMMARY

An outbreak of gastrointestinal illness affecting 12 of 29 customers of a 'Hawaiian' theme restaurant specializing in stir-fried food occurred in Cardiff, Wales in February 1997. *Campylobacter jejuni* serotype HS50 phage type 49 (PT49) was isolated from 5 cases. A total of 47 isolates of *C. jejuni* HS50 PT49 were identified from Wales during 1997, of which 11 were isolated in late February or early March and from the Cardiff area. In the outbreak, illness was associated with eating stir-fried chicken pieces (relative risk 4.81, 95% confidence interval (CI) 0.76–30.44, $P = 0.03$) and a dose-response relationship between risk of illness and amount of chicken consumed was observed (χ^2 -test for linear trend 3.96, $P = 0.047$). Undercooking of chicken was probably due to a combination of inadequate cooking time and use of large chicken pieces. This is the first time that stir-fried food has been associated with a campylobacter outbreak. The incident also illustrates the value of routine campylobacter subtyping in supporting outbreak investigation.

INTRODUCTION

Although campylobacter is the commonest bacterial enteric pathogen isolated in the United Kingdom, general outbreaks of campylobacter infection are unusual [1–3]. During 1992–4, 21 general outbreaks were reported in England and Wales of which 8 were related to food (mainly poultry), 6 to contaminated water, 4 to contaminated milk and in 3 the route of transmission was unknown [3].

Unlike salmonella infection, whose epidemiology has been clarified by the availability of reference typing, the lack of this facility for campylobacter has made it difficult to recognize and investigate outbreaks

[4, 5]. We describe a foodborne campylobacter outbreak and the role of a new national reference typing service in its investigation.

THE OUTBREAK

In February 1997, gastrointestinal illness was reported in members of 2 parties (1/2 and 11/27) who had eaten at the same restaurant on the same evening over a week previously. Five of 7 faecal specimens were positive for *Campylobacter* sp. Initial investigations found that the restaurant offered an a la carte menu and a 'sizzling wok special'. This is a choice of raw meats and vegetables from which the customer

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chooses, fills a bowl, and hands to the chef to stir-fry on a large wok. The meal is served with rice and a selection of commercially prepared sauces. We carried out a cohort study and environmental investigations in order to identify the vehicle of infection and source of the outbreak.

METHODS

Epidemiological investigation

A list of all individuals who had attended the restaurant was obtained from members of both parties. The implicated restaurant was visited and credit card receipts examined for details of other restaurant patrons. All recent campylobacter isolates from the south Wales area were reviewed. Persons with campylobacter isolates of the same serotype and phage type as the outbreak strain were interviewed and details obtained of recent food histories and of any link with the implicated restaurant.

A cohort study was conducted to test the hypothesis that infection was associated with consumption of one or more ingredients of the 'sizzling wok special'. Cases were defined as persons ill with diarrhoea or abdominal pain more than 24 h after eating at the restaurant. Interviews were conducted by environmental health officers over the telephone (or if unavailable, at a home visit) using a structured questionnaire. Subjects were asked about gastrointestinal illness, household contacts with diarrhoea, and a complete list of all food items eaten at the restaurant.

Environmental and microbiological investigation

The premises was inspected by an environmental health officer. Food hygiene standards were reviewed, food preparation and cooking processes examined and leftover food samples sought. Faecal samples were requested from all the ill restaurant customers identified.

Faecal specimens were cultured for bacterial pathogens including salmonella, campylobacter and shigella. All campylobacter isolates were referred to the Campylobacter Reference Unit at the Laboratory of Enteric Pathogens, Central Public Health Laboratory, London for speciation and typing. Campylobacter was speciated by conventional methods [6], serotyped using a direct agglutination method for the

identification of heat stable antigens [7] and phage typed [8].

Data analysis

Data were analysed using Epi Info Version 6 [9]. Food preference tables were constructed and relative risks with Taylor series 95% confidence intervals (CI) calculated. Differences in categorical variables were tested using Mantel-Haenszel χ^2 with Yates' correction or two-tailed Fisher's exact test.

RESULTS

Epidemiological investigation

Completed questionnaires were obtained from 2/2 and 21/27 party members. Review of other campylobacter isolates of the same serotype and phage type subsequently identified another case who had eaten at the same restaurant. Among the questionnaire respondents there were 12 cases (7 male) with a median age of 27 years (range 24–34 years). Median incubation period for illness was 79 h (35–68 h) and the main symptoms were abdominal pain (100%), headache (100%), diarrhoea (92%) and fever (83%). Median duration of illness was 6.5 days (2–15 days), four cases consulted a doctor and one case was admitted to hospital for 6 days.

Three party members were vegetarians, none of whom was ill. The only food significantly associated with illness was unmarinated chicken served as part of the 'sizzling wok special' (RR 4.81, 95% CI 0.76–30.44, $P = 0.03$) (Table 1). Neither chicken wings (served as a starter) nor marinated chicken (an ingredient option for the 'sizzling wok special') were associated with illness. A dose-response effect between eating unmarinated chicken and risk of illness (χ^2 test for linear trend 3.96, $P = 0.047$) (Table 2) was also observed.

Environmental and microbiological investigation

The premises was a 'Hawaiian' theme restaurant specializing in stir-fry foods. The general structural condition of the premises was satisfactory but neither of the two main food handlers had undergone food hygiene training and food storage practices were poor with potential for cross-contamination between raw poultry and cooked meats or vegetable produce. No

Table 1. Food-specific illness attack rates for restaurant customers, Cardiff, Wales, February 1997

Food eaten	Exposed			Not exposed			Relative risk (95% CI)
	Ill	Total	(%)	Ill	Total	(%)	
Chicken wings	10	16	62.5	2	7	28.6	2.19 (0.64-7.49)
Garlic mushrooms	8	16	50.0	4	7	57.1	0.88 (0.39-1.96)
Vegetarian	0	3	0	12	20	60.0	Undefined
Mushrooms	10	19	52.6	2	4	50.0	1.05 (0.36-3.07)
Bamboo shoots	6	15	40.0	6	8	75.0	0.53 (0.26-2.12)
Beansprouts	9	18	50.0	3	5	60.0	0.83 (0.36-1.95)
Pineapple	3	7	42.9	9	16	56.3	0.76 (0.29-1.99)
Green beans	8	13	61.5	4	10	40.0	1.54 (0.64-3.68)
Water chestnuts	4	10	40.0	8	13	61.5	0.65 (0.27-1.56)
Sweet peppers	10	19	52.6	2	4	50.0	1.05 (0.36-3.07)
Onions	7	13	53.8	5	10	50.0	1.08 (0.48-2.39)
Unmarinated chicken	11	16	68.8	1	7	14.3	4.81 (0.76-30.44)*
Marinated chicken	8	15	53.3	4	8	50.0	1.07 (0.46-2.47)
Unmarinated lamb	6	9	66.7	6	14	42.9	1.56 (0.73-3.33)
Marinated lamb	7	11	63.6	5	12	41.7	1.53 (0.68-3.42)
Unmarinated beef	6	11	54.5	6	12	50.0	1.09 (0.50-2.38)
Marinated beef	3	7	42.9	9	16	56.3	0.76 (0.29-1.99)
Any marinated meat	10	17	58.8	2	6	33.3	1.76 (0.53-5.86)
Seafood	2	6	33.3	10	17	58.8	0.57 (0.17-1.88)
Soya meat	0	2	0	12	21	57.1	Undefined
Rice	11	22	50.0	1	1	100	0.50 (0.33-0.76)

* $P = 0.03$.

Table 2. Amount of stir-fried chicken eaten at restaurant meal, Cardiff, Wales, February 1997 and risk of illness ($n = 23$)

Amount eaten	Exposure		Attack rate		Odds ratio
	score	Ill	Not ill	(%)	
None	0	1	6	14.2	1.00
Small	0.5	1	0	100	Undefined
Moderate	1	7	4	63.6	10.5
Large	2	3	1	75	18.0

χ^2 test for linear trend 3.96, $P = 0.047$.

formal risk hazard assessment had been undertaken. The cooking area was situated in the restaurant adjacent to a refrigerated display unit containing cooked and raw foods. Cooking equipment included a commercial oven grill and a large dome-shaped gas-fired hot plate used to prepare 'sizzling wok specials'. The wok was approximately 1.5 m in diameter and of sufficient size to allow 8 meals to be stir-fried simultaneously by two chefs at peak periods.

Fresh chicken breasts and chicken wings were supplied by a local butcher who obtained poultry from a variety of wholesalers. It was not possible to trace the implicated batch of chicken to source. Strips of chicken, beef and pork were cut and prepared daily

for the 'sizzling wok special'. Some meat strips, and the chicken wings, were marinated in lemon juice and garlic (pH 1.9) for at least half an hour before use. Chicken wings were char grilled before being oven cooked. Ingredients for the stir-fry meal were chosen by the customer from a refrigerated display of meat (marinated and unmarinated), seafood, soya meat and vegetables, then stir-fried by a chef on the wok. Interviews with staff revealed that on some occasions meat strips had been cut too thickly and had been returned to the preparation area by the chef.

Faecal samples were obtained from 7 of 12 cases and of these, 5 were positive for *C. jejuni* HS50 PT49. A total of 591 isolates of *C. jejuni* HS50 were identified

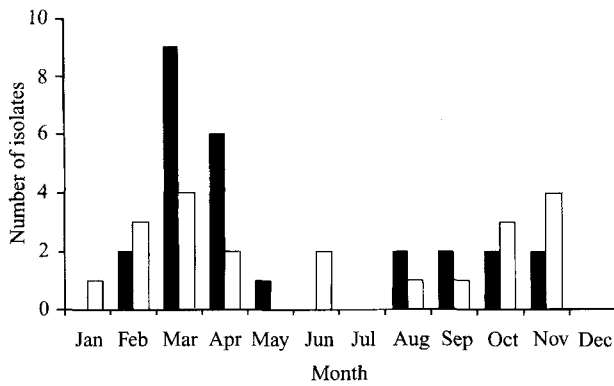


Fig. 1. Number of isolates of *Campylobacter jejuni* serotype HS49 PT50 from Wales by area of residence and month, 1997: ■, Cardiff area; □, other.

among the 2256 isolates referred to the reference laboratory from Wales during 1997. Of these, 47 belonged to phage type 49, 11 of which were isolated in late February or early March from the Cardiff area (Fig. 1). No food samples were available for microbiological analysis.

DISCUSSION

In this outbreak, epidemiological evidence implicated stir-fried unmarinated chicken pieces as the vehicle of infection. It was the only food exposure associated with illness and there was a significant dose-response relationship between risk of illness and amount of chicken consumed. Marinated stir-fried chicken was not associated with illness, reflecting the fact that campylobacters do not survive acidic conditions [5, 10]. The cause of the outbreak may have been either undercooking or cross-contamination or both. Cross-contamination might have occurred if the same implements were used by the chef for handling raw ingredients and cooked food or if the same bowls were used for choosing raw ingredients and serving the cooked meal. However, neither of these were reported to have occurred and the finding that chicken was the only food item associated with illness rather than a range of foods supports the view that the outbreak was caused by undercooked chicken. Undercooking may have occurred either because the chicken pieces were cut too large, cooking time was too short or there was insufficient direct contact between the food and wok surface. Cooking time may have been compromised by the necessity to prepare food promptly for a large party of customers. Since the outbreak, the restaurant has altered its cooking procedures; meals are now ordered in a conventional way and chicken

breasts stir-fried separately on the hot plate to ensure thorough cooking.

Foodborne campylobacter outbreaks are uncommon and usually due to raw milk, contaminated pasteurized milk or undercooked poultry [1-3, 11]. Raw chicken is frequently contaminated with campylobacter [12, 13], and although campylobacter does not multiply on food, illness can follow consumption of a relatively small dose [14]. Circumstances in which outbreaks associated with poultry have occurred include undercooked barbecued chicken [15], inadequately defrosted chicken in a casserole [16], failure to follow cooking instructions [17] and cross-contamination of lettuce from raw chicken [18]. To our knowledge, this is the first time that stir-fried food has been associated with a campylobacter outbreak. Presumably this is because the stir-fry cooking process normally achieves very high cooking temperatures and involves only small pieces of food. The outbreak therefore highlights the potential for even normally 'safe' cooking procedures to go wrong and underlines the importance of good food hygiene training.

The outbreak also shows the potential value of routine subtyping of campylobacter strains. Most campylobacter infections are reported as sporadic but the combination of a low infectious dose and relatively long incubation period means that outbreak recognition is difficult. This is compounded by the large number of infections reported and the lack of detailed typing data. This outbreak occurred while routine typing of campylobacter infections was being evaluated. Follow up of cases infected with *C. jejuni* of the same serotype and phage type led to another case associated with the implicated restaurant being identified. The cluster of cases in the Cardiff area during February and March may indicate distribution of contaminated chicken from an unidentified local producer. It is anticipated that the availability of reference typing will facilitate further studies on the epidemiology of campylobacter infection and enhance the value of routine follow up of campylobacter cases.

'Hawaiian' or 'Mongolian' style restaurants are a relatively new phenomenon. Customers start their meal by selecting the raw ingredients from an extensive range of meat, fish and vegetables. The food is then cooked on a griddle or stir-fried in a huge wok, sometimes by the customers themselves. Restaurants providing this kind of menu appear to be gaining in popularity [19] and, as our experience shows, they may pose a novel food safety hazard. We would alert

agencies involved in monitoring food hygiene standards to this new trend and to potential deficiencies in cooking practice such as we describe.

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