

data ; to the house staff, sisters, and nurses ; to the many consultants and general practitioners who referred patients ; and to the patients themselves for their co-operation in the metabolic studies. One of us (A.N.) is in receipt of a Commonwealth Scholarship, United Kingdom award and another (N.T.) is supported by a W.H.O. Fellowship.

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## Outbreak of Food-poisoning Caused by *Salmonella virchow* in Spit-roasted Chicken

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**Summary:** *Salmonella virchow* food-poisoning acquired from eating chicken caused illness in at least 50 people who attended a tennis club function in Liverpool, and in many other people in the Merseyside area. In some cases the illness was severe, with positive blood cultures, and 35 people were admitted to hospital.

The source of infection was a retail shop which received deep-frozen chickens already contaminated with *S. virchow* from a packing-station in Cheshire. These chickens were spit-roasted after inadequate thawing and subsequently handled under unhygienic conditions. The result was a massive build-up of salmonella contamination in the shop and in the chicken portions sold.

*S. virchow* was isolated from over 160 patients and contacts in the Merseyside area during the outbreak and many continued to excrete the organism in the faeces after four months. Antibiotic treatment was not recommended because there was no evidence that it shortened the duration of excretion.

A high rate of contamination of chickens from a packing-station by a salmonella type capable of causing serious disease in man is clearly a public health problem which cannot be ignored.

The use of rotary spits for roasting chickens requires thorough investigation and appraisal, because as operated at present they evidently constitute a public health hazard.

### Introduction

*Salmonella* infection of chickens dressed in broiler packing-stations has been the subject of recent reports from Britain (Dixon and Pooley, 1961), Canada (Magwood *et al.*, 1967), and U.S.A. (Wilson *et al.*, 1961); Woodburn, 1964; Wilder and MacCready, 1966). This represents a serious public health hazard because the salmonellae may be present not only on the surface but also in the deep tissues of the chickens, and if these organisms are to be destroyed in the cooking process this must be such as to ensure adequate penetration of heat to the interior of the bird. We describe here an outbreak of food-poisoning by *Salmonella virchow* which occurred because infected chicken carcasses were sent from a packing-station to a retail establishment where they were inadequately cooked on a spit-roaster and handled under unhygienic conditions. This led to an overwhelming build-up of salmonella contamination of the premises.

### The Outbreak

As a result of a telephone call on 3 July 1968 from a general practitioner about a possible outbreak of food-poisoning, immediate investigation showed that many persons had been affected, some requiring admission to hospital, among those who had attended a tournament at a suburban tennis club on Saturday 29 June.

The food served at the club consisted of quarters of spit-roasted chicken, salad, cakes, fruit jelly, and ice-cream. Epidemiological inquiries quickly established that all the affected persons had eaten the chicken, most of them at about 5 p.m.; some remaining portions of chicken were eaten at about 10 p.m.,

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and those who ate the chicken late were among the most severely ill.

By the next day, Sunday 30 June, many of those who had eaten the meal were ill with abdominal pains, diarrhoea, and prostration. Other clinical features included pyrexia, headaches, rigors, nausea, and vomiting. Two or three days after the initial symptoms some patients had a second bout of pyrexia with a return of abdominal symptoms which were often severe and persisted for several days.

Of the estimated 120 persons who ate the tennis club meal, 11 were so ill that they required admission to hospital, but many others were cared for by their general practitioners. Of 80 persons in the Liverpool area who were traced, 50 were found to have had symptoms and to be excreting *S. virchow* in the faeces.

As these investigations were going on it became clear that there were many other patients with *S. virchow* infections in the Merseyside area in addition to those associated with the tennis club. In the 11 weeks between 15 June and 31 August *S. virchow* was isolated from 162 cases or contacts in the Merseyside conurbation, whereas there had not been a single instance of such isolation in the 11 weeks immediately before this. By September the worst of the outbreak appeared to be over; in the first two weeks of the month *S. virchow* was isolated from only two persons in Merseyside.

Nearly all those with *S. virchow* infection were found when questioned to have eaten chicken shortly before the onset of their illness. Altogether 35 persons required admission to hospital, where they stayed for periods ranging from 11 to 21 days. Blood cultures were taken from 21 of these patients during the acute stage of the illness and *S. virchow* was isolated from eight. In view of the severity of the illness, a disturbing feature of the outbreak was the considerable number of patients who continued to excrete *S. virchow* after clinical recovery. For example, of the 11 tennis club patients admitted to hospital eight were still excreting *S. virchow* after discharge.

The organism was sensitive to ampicillin, nalidixic acid, neomycin, and streptomycin and weakly sensitive to tetracycline, but antibiotic treatment did not appear to have much effect on the clinical course of the disease or on the excreter state.

### Chicken Supplied to Tennis Club

One hundred and twenty portions of cooked and quartered roast chicken had been ordered in advance from a Liverpool cooked-meat shop which also sold sandwiches and other open foods for consumption off the premises. Frozen eviscerated chickens had been obtained by this shop on 28 June, from the firm's usual suppliers, a Cheshire packing-station which received live chickens from a group of 16 farms in the surrounding area.

The frozen chickens were stored overnight in a deep-freeze cabinet, removed at 8 a.m. on 29 June, allowed to thaw out partially at room temperature for about two hours, and then cooked for one and a half hours on rotating spit-roasters in the basement kitchen. A further 30 minutes at basement temperature was allowed for cooling, and the cooked chickens were then manually quartered with secateurs, wrapped in greaseproof paper while still warm, and packed into two cardboard boxes.

These cardboard boxes containing the 120 chicken portions were delivered to the tennis club at 1.10 p.m. and remained unopened in the tennis pavilion kitchen until 4.30 p.m., when about 100 portions were removed and eaten by the club members and their guests; all the remaining portions were eaten later, at about 10 p.m. The day was hot and humid. At Speke Airport, 3½ miles (5.5 km.) away, the noon temperature was 64.6° F. (18.1° C.). At 6 p.m. and 10 p.m. the temperatures were 69.3° F. (20.7° C.) and 68.7° F. (20.4° C.) and the relative humidities 63% and 81% respectively.

### Conditions in Shop

The entire food hygiene standard of the basement kitchen was very poor. The working space was inadequate for the amount of food preparation undertaken. The same working surfaces for raw and cooked chickens were used. No regular daily schedule existed for cleaning working surfaces, equipment, spits, or ovens. There was considerable evidence of rat and mouse infestation in the kitchen.

The cooking of the chickens was carried out in this basement kitchen, which was subject to overheating when the spit-roaster or other equipment was in operation. It also contained the deep-freeze cabinet which was used to store other cooked meats as well as raw chickens, clearly increasing the risk of cross-infection.

After removal from the deep freeze the chickens were allowed only two hours for thawing, much less than the 8 to 10 hours which our investigations showed were necessary. Unless thawing is complete there is a risk that the subsequent spit-roasting will not raise the temperature of the interior of the chicken sufficiently to destroy the salmonellae; it certainly failed in this instance. Three cooked chicken portions from the shop were examined on 4 July and another 10 on 8 July; *S. virchow* was isolated from all of them.

Any surplus cooked chicken was taken upstairs and placed in the refrigerated window display cabinet for public sale or for making sandwiches. Several hundred chickens were prepared by this method each week for public sale, bulk orders, and distribution to other food establishments for sale—for example, certain fish-and-chip shops.

Of the 11 staff employed on the premises eight were found to be excreting *S. virchow*, including an untrained youth of 16 to whom was left the chicken preparation, cooking, and packing largely without supervision. *S. virchow* was also isolated from 13 family contacts of the staff of the shop.

Samples of several other open foods sold by the shop were examined, including ox tongue, roast beef, and cream cheese. *S. virchow* was isolated from the cream cheese. In addition, five cases of illness with infection were traced to this source among office employees not connected with the tennis party. They bought cheese and prawn sandwiches and developed their illness 24 hours later. In the Liverpool city area 32 other cases of *S. virchow* infection were traced to chicken supplied either direct to the consumer by the food shop or through other restaurants or food shops supplied from the basement kitchen. In all we traced about 130 persons infected either directly or indirectly from this food shop.

The food shop was closed on 6 July, immediately the unsatisfactory conditions came to light. When eight of the staff were found to be infected, arrangements were made for their medical care. The public health inspectors co-operated with the firm to get the necessary structural and other alterations done to improve conditions in the basement kitchen. The extermination of the rats and mice also proceeded and a rigid schedule of cleanliness, together with better and continuous supervision, was required. After an interval of three weeks it was possible to allow the food shop to open again, but with visits twice daily from the public health inspectors.

### Source of the Chicken Contamination

On 5 July three chicken carcasses were examined from a box supplied by a Cheshire packing-station and *S. virchow* was isolated from all of them. It was clear that a high proportion of chickens being dispatched from this station were contaminated. This was confirmed by the findings of the medical officer of health for the area and the director of Chester Public Health Laboratory, who reported isolating *S. virchow* from chickens at the packing-station and on the farms which supply the station with chickens; and the veterinary

investigation officer isolated the organism from the dust of the hatchery which supplies day-old chicks to the farms (Pennington *et al.*, 1968).

### Discussion

*S. virchow* is not a common cause of food-poisoning. In 1966 of 2,496 incidents of salmonella food-poisoning reported to the Public Health Laboratory Service, only two were caused by *S. virchow* (Vernon, 1967). The records of the Epidemiological Research Laboratory of the P.H.L.S. show, however, that between October and December 1967 *S. virchow* was isolated from a number of cases of food-poisoning in the Bolton area, and at this time there were a few cases on Merseyside. During the early months of 1968 *S. virchow* was isolated from only one patient in Liverpool, but in June the organism reappeared first in a few isolated cases or families and then at the end of the month in the tennis club outbreak described here. In the following weeks *S. virchow* was isolated from many other cases of food-poisoning and contacts in the Merseyside area.

Nearly all those involved had eaten chicken, in many instances from the shop which supplied the tennis club or from restaurants which obtained their supplies from the shop. In some cases the illness was relatively severe with positive blood cultures and debilitating enteritis.

The cause of the outbreak was, in the first place, the high rate of *S. virchow* contamination in dressed chickens distributed from a packing-station in Cheshire. It is not the purpose of this communication to discuss the problem of extensive salmonella contamination of chickens which may occur during dressing in the packing-station or, as apparently in this instance, before the birds reach the station (Pennington *et al.*, 1968). It is clear, however, that when a high proportion of chickens going to the retail market are contaminated with a type of salmonella capable of causing serious disease in man this is a public health hazard which cannot be ignored.

The second major factor responsible for the outbreak was the unsatisfactory handling of the chickens in the shop, which led to the distribution to the public of heavily contaminated food. The chickens were not properly thawed out before spit-roasting and the temperature inside the birds did not, in the one and a half hours' cooking time allowed, reach that required to kill salmonellae. Thus the spit itself was contaminated, and, as a result of the quartering of cooked birds, so were hand instruments and working surfaces and, inevitably, other chickens cooked and quartered subsequently. The whole operation was carried out in restricted basement accommodation which was badly ventilated and hot; this must also have favoured a massive build-up of salmonella contamination.

The circumstances which led to this outbreak indicate that there is a need for thorough investigation and critical appraisal of the use of rotary spits in commercial practice because as operated at present they constitute a public health hazard. Thus there is a need for an accurate definition of the time-temperature

requirements for both the thawing of deep-frozen broiler chickens and their subsequent cooking. We have recommended provisionally that for adequate thawing eight hours at room temperature is required and for oven roasting 375–400° F. (190–204° C.) for 30 minutes per pound (450 g.) weight. Experiments to verify these recommendations are in progress.

We believe that commercial spit-roasting of chickens often does not meet these requirements. It is clear, for example, that time must be allowed for the spit to warm up before cooking starts and that the transparent doors must be kept closed. For the cutting of roast chicken into portions a high standard of hygiene is essential with careful attention to the proper cleaning of instruments and working surfaces and a rigid separation of cooked from uncooked chickens. Cooked portions not eaten immediately should be cooled rapidly and kept at below 40° F. (4.4° C.), until required; any reheating should be at a temperature high enough to ensure that no opportunity is provided for bacterial multiplication.

One aftermath of this outbreak of salmonella food-poisoning has been the large numbers of patients and contacts who have gone on excreting *S. virchow* in the faeces for months after the initial infection. Dixon (1965) found that antibiotic treatment does not reduce the duration of excretion and may indeed prolong it. We agree with Taylor (1963) that excretors should not be given specific antibiotic therapy, and we have advised practitioners accordingly. It is important, however, that people excreting salmonellae should be given appropriate advice about personal hygiene and that food-handlers should not be allowed to resume this occupation until salmonellae have not been isolated from three consecutive faecal samples.

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