

Bacterial hazards

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Bacterial food poisoning is a disturbance of the gastrointestinal tract; symptoms follow consumption of food containing large numbers of certain types of bacteria or the toxic products of their growth. Between 8000 and 12 000 cases of food poisoning are notified each year in England and Wales, the number of reported outbreaks increasing during prolonged hot weather as in the summers of 1975 and 1976. Undoubtedly many cases go unreported. Table 1 shows the causative organisms and the characteristic clinical and epidemiological features of outbreaks. *Clostridium welchii* outbreaks show no seasonal pattern of incidence, but there is a tendency for outbreaks of *Salmonella*, *Staphylococcus aureus* and *Bacillus cereus* food poisoning to increase in number during the summer months due to the rise in atmospheric temperature.

Bacteria have specific growth requirements, they can survive indefinitely in dried foods and will only grow if sufficient moisture is present. Most require air (oxygen) for active growth whilst others e.g. the clostridia, will only grow in the absence of oxygen. The most favourable temperature for growth of food poisoning bacteria is 37°C (98.6°F) although most will multiply between 10° and 45°C (50°–113°F); *Cl. welchii* will grow well at temperatures up to 50°C (122°F). Effective substrates (foods) are rich in protein and include meat poultry, milk and eggs. Time is needed for multiplication to occur; a single bacterium dividing every 15 to 30 min in favourable conditions can result in the production of seven million organisms in 7 h.

Salmonella infection accounts for about 70–80% of cases of food poisoning in this country. More than 1600 serotypes of *Salmonella* are recognized. *Salmonella typhimurium* is the commonest single serotype infecting humans in England and Wales; other serotypes frequently implicated include *S. agona*, *S. enteritidis*, *S. infantis*, *S. newport* and *S. panama*. The introduction of hitherto rare serotypes such as *S. agona* and *S. virchow* into the food chain in Britain has led to the establishment and widespread dissemination of these types in the human and animal populations. In recent years about 70% of *Salmonella* outbreaks, in which the vehicle of infection was determined, have been associated with the consumption of meat and poultry, and all but one of the remainder were from unpasteurized milk. Meat, poultry and milk are usually contaminated at source. The organism may survive and multiply as a result of inadequate cooking and poor

Table 1. *Some clinical and epidemiological features of bacterial food poisoning*

Causative organism	Incubation period (h)	Duration and symptoms	Remarks	Foods frequently implicated
<i>Salmonella</i>	6-48 usually 12-36	Diarrhoea, abdominal pain and vomiting. Fever nearly always present	Organism easily destroyed by heat	Cooked meat and poultry, and raw milk
<i>Staphylococcus aureus</i>	2-6	6-24 h Nausea, vomiting, diarrhoea and abdominal pain, but no fever. Collapse and dehydration in severe cases	Organism readily destroyed by heat, toxin gradually destroyed by boiling	Cooked meat and poultry and sometimes dairy products and cooked fish and seafoods
<i>Clostridium welchii</i> (<i>Cl. perfringens</i>)	8-22	12-24 h Diarrhoea, abdominal pain, nausea but rarely vomiting, no fever	Spores of some strains survive hours of boiling. Cooking heat activates spores. Rapid germination and multiplication during long slow cooling of meat dishes	Cooked meat and poultry
<i>Clostridium botulinum</i> (Rare in UK last recorded in 1955)	usually 18-36	Death in 24 h to 8 d or slow convalescence over 6-8 months. Variable symptoms but usually include disturbances of vision and difficulties in speaking and swallowing. Mucous membranes of mouth, tongue and pharynx usually very dry. Progressive weakness and respiratory failure	Spores resistant to boiling or even higher temperatures. Toxin easily destroyed by heat	Home canned foods (except acidic products such as fruit) and uncooked, fermented lightly smoked fish and other seafoods
<i>Vibrio parahaemolyticus</i>	2-28 usually 12-18	2-5 d Profuse diarrhoea often leading to dehydration, abdominal pain, vomiting and fever	Organism readily destroyed by heat	Raw and cooked seafoods e.g. fish, prawns, crabs and other shellfish
<i>Bacillus cereus</i>	(a) 8-16 diarrhoeal type (b) 1-5 vomiting type 12-72	(a) 12-24 h abdominal pain, diarrhoea and sometimes nausea (b) 6-24 h nausea and vomiting and sometimes diarrhoea	Spores survive cooking, germinate and grow during storage at unsuitable temperatures	(a) meat products, soups, vegetables, puddings and sauces (b) boiled and fried rice
<i>Escherichia coli</i>	1-7 d	(a) cholera-like illness with watery diarrhoea and pain (b) resembling dysentery-prolonged diarrhoea with blood and mucus in the stool	Organism easily destroyed by heat	Few well documented outbreaks but cheese and cooked meats have been incriminated

storage, but more frequently the fault is cross-contamination from raw to cooked foods via hands, surfaces, equipment and utensils.

Vibrio parahaemolyticus food poisoning is associated with the consumption of raw and cooked seafoods. Outbreaks are usually the result of inadequate cooking, cross contamination and warm storage.

Staphylococcus aureus can be transferred from skin, cuts and boils to foods by handling; a heat-resistant toxin may be produced during growth of the organism in a suitable substrate. In contrast, the spores of *Cl. welchii* survive normal cooking and are activated during long, slow cooling and warm storage, particularly in large bulks of meat, meat dishes and poultry. A toxin is produced when the organism sporulates in the intestine after consumption of food.

In this country outbreaks of *B. cereus* food poisoning are associated with cooked rice, usually fried rice from Chinese restaurants and 'take-away' shops. The spores of *B. cereus* can survive normal cooking and will germinate during long slow cooling and warm storage, particularly in large bulks of rice.

The incidence of food poisoning can be reduced by adequate cooking, by reducing the spread of contamination in the kitchen and by preventing the multiplication of bacteria in food. In pursuing these aims attention should be paid to hygiene by the food handler who should wash his or her hands between processes, especially after handling raw meat and poultry, and who should manipulate cooked food with implements and utensils and not with the hands. Efficient cleaning and disinfection of working surfaces, equipment and cleaning materials (cloths, etc.) must be carried out regularly. Particular attention should be paid to storage, cooked foods must be either efficiently refrigerated at 4–5°C or the time gap between preparation and serving reduced to a minimum. Provision should also be made for rapid cooling by breaking down large bulks of food into small units. Careful preparation and adequate cooking will destroy most bacteria and if possible food should be served when it is hot, otherwise hold at a temperature above 63°C (145°F) or cool rapidly and refrigerate. If food must be re-heated it must be thoroughly boiled or heated right through in an oven.

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