

Cases of Human Intoxication Due to Staphylococcal Enterotoxins from Contaminated Doner Kebab Dishes

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Abstract

We report a small outbreak with five persons who were intoxicated after having eaten dishes of a doner kebab shop. An official control action in the shop identified poor personal hygiene, wrong technical handling of several working processes and inadequate temperature management with ready-to-eat meat which was held at 40 to 44 °C. Bacteriological analysis combined with PFGE-typing demonstrated large scale cross-contamination with a particular strain of Staphylococcus aureus. In the ready-to-eat food samples, counts as high as $>1.5 \times 10^8$ cfu per gram were measured. The concerned shop was temporarily closed and only allowed to reopen after having entirely eliminated all the identified weak points. Important official directions were that spits with meat, which are not completely used in a working day, have to be kept overnight at freezing temperatures and that holding temperatures have to be at > 65 °C throughout the opening hours of the shop. To our knowledge, this is the first report on intoxications with staphylococcal enterotoxins caused by meat dishes such as doner kebab.

Key words: Outbreak, enterotoxins, staphylococci, fast food, hygiene

Introduction

In Switzerland, outbreaks caused by staphylococcal enterotoxins (SET) have to be reported mandatorily to the Federal Office of Public Health (FOPH). Such outbreaks became quite rare and only 11 of them were registered in the thirteen years from 1994 to 2006 (Baumgartner, 2008). In 2008, the State Food Law Enforcement Authority in Solothurn reported the occurrence of a small SET-outbreak. Interviews with patients directed the suspicion to a food corner selling doner kebab dishes. In an official control action, severe hygienic deficiencies were identified. Bacteriological tests with various samples and testing for SET confirmed the hypothesis that contaminated kebab dishes caused the outbreak. There was enough evidence for the responsible authorities to temporarily close the concerned food business and to decree measures of correction. Since the hygienic shortcomings and the extent of bacterial contamination were remarkable, it was decided at a later stage to type coagulase positive staphylococci which were isolated along the outbreak investigation. The data from these experiments were not needed to justify legal

measures but they were useful to better understand the reasons causing this outbreak.

Material and Methods

Epidemiological investigation. The control authorities noticed 5 persons who were intoxicated within 2 to 6 hours after consumption of contaminated doner kebab dishes. Four of them went directly to the emergency unit of a city hospital. Short interviews with the patients allowed postulating that intoxications with a bacterial toxin could have occurred and that a kebab shop might be at the origin of the outbreak. During the inspection of the suspected place, the following samples for laboratory tests were taken: raw kebab meat from pre-packed kebab spits, raw kebab meat from grill stations, various samples of grilled ready-to-eat kebab meat out of bain-maries, as well as samples of ready-to-eat salads and mushrooms. In a follow-up check for verification of correction actions, again ready-to-eat food samples were taken, i.e. originally canned corn.

Bacteriological and immunochemical tests. Testing for coagulase-positive staphylococci was done with ISO 6888-2, which is the official method in the EU and in Switzerland. Ready-to-eat samples with counts of >100 cfu/g were

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considered as not conform. Isolates for molecular typing were first confirmed with additional biochemical tests (API Staph, BioMérieux). For detection of SET in 10 samples of ready-to-eat kebab meat, the Vidas Staph Enterotoxin II test was used.

Pulsed-field gel electrophoresis (PFGE). PFGE was performed on coagulase-positive staphylococci (*S. aureus*) from food samples of the initial control and a follow-up control in a doner kebab shop. For digestion, Xba I was used and for quality control *S. aureus* strain NCTC 8325 (Murchan et al., 2003).

Results and Discussion

As shown in Table 1, coagulase-positive staphylococci were isolated from various samples of either ready-to-eat meat or raw and sliced meat from spits at grill stations. In the three samples that were ready-to-eat and hold at 40 °C to 44 °C, the bacterial counts were extremely high ($> 1.5 \times 10^8$ cfu/g) indicating severe hygienic weak points and inadequate temperature management in the concerned food business. Coagulase-positive staphylococci were also isolated from canned mushrooms and from a sample of raw, pre-packed chicken kebab. Furthermore, staphylococcal enterotoxin B was detected in one sample of sliced and ready-to-eat chicken kebab meat. These analytical facts, together with the data collected in interviews with patients, revealed enough evidence for the responsible authorities to conclude that the suspected shop was responsible for an outbreak with SET. The concerned shop was temporarily closed until the necessary hygienic improvement was realized.

After implementing various control measures, i.e. assessment and monitoring of temperature management, the concerned business was inspected again. In this context, canned corn was sampled and tested in the laboratory where coagulase-positive staphylococci were proven by counts of 400 cfu/g as shown in Table 1.

Data of PFGE analysis allowed shedding more light on the dynamics of the observed contamination. First, it could be shown that all the contaminations in foodstuffs collected during the first intervention, including raw and ready-to-eat kebab meat, ready-to-eat salads and mushrooms, were caused by the same strain represented by profiles 2 to 8 in Figure 1. This finding demonstrates that serious cross-contaminations must have occurred.

As shown in Figure 1 by profile 10, PFGE-analysis of the sample which was collected during the follow-up inspection revealed the same profile as the outbreak strain indicating that these particular staphylococci were still present in the facility. However, the isolate from a spit with raw and pre-packed chicken kebab that was stored in a freezer and collected during the first intervention showed a different PFGE-profile (profile 9 in Figure 1). Therefore, it could be concluded that in this case the outbreak strain was not imported into the kitchen by raw kebab meat. In the end however, the origin of the toxin producing strain remained unknown. The hypothesis that the strain originated from a shedder among the kitchen workers could not be further tested.

The inspection uncovered different and apparent hygienic deficiencies. Ready-to-eat kebab meat was hold between 40 to 44 °C for several hours and contaminated kebab spits were not adequately stored over night. Most strains of *S. aureus* are able to grow at temperatures around 40 °C and start to produce toxins such as SET if colony counts reach numbers $> 1.0 \times 10^5$ cfu/g. Furthermore, process hygiene was insufficient. There was only one knife available to cut all three types of kebab meat and regular cleaning of the knife was not defined. The duties with regard to cleaning work in the shop were not defined. Personal hygiene was poor and hand-washing between different working processes not practiced. All those factors contributed to the observed broad spread and growth of a particular *S. aureus* strain. One plausible explanation for the very high counts of *S. aureus* detected in raw and ready-to-eat kebab meat might be that after business hours, partially used spits were

Table 1 Bacteriological analysis for coagulase-positive staphylococci in food samples taken in an outbreak investigation and in a sample from a follow-up inspection by control authorities.

Food	Staphylococcal count (cfu / g)	PFGE-profile (Figure 1)
Chicken kebab from bain-marie, RTE ¹	$> 1.5 \times 10^8$	2
Calf kebab from bain-marie, RTE ¹	$> 1.5 \times 10^8$	3
Beef kebab from bain-marie, RTE ¹	$> 1.5 \times 10^8$	4
Chicken kebab raw from spit at grill station ¹	2.1×10^8	5
Calf kebab raw from spit at grill station ¹	6.3×10^6	6
Beef kebab raw from spit at grill station ¹	7.1×10^6	7
Canned mushrooms, RTE ¹	2.4×10^3	8
Chicken kebab raw from pre-packed spit ¹	3.0×10^2	9
Canned corn, RTE ²	4.0×10^2	10

RTE: Ready-to-eat; ¹Sample from outbreak investigation; ²Sample from follow-up inspection.

were kept on the grill station overnight at room temperature. As key measures it was therefore ordered that partially used spits must be hold overnight at minus temperatures in a freezer until further used in the following day and that ready-to-eat meat must be hold at temperatures $> 65^{\circ}\text{C}$ during business hours.

Doner kebab is very popular, particularly among young people, and take-away restaurants selling this kind of dishes are numerous in European countries. However, studies which envisage the hygiene of doner kebab are rather rare. Worth mentioning is a recent study of Meldrum et al. (2009) who bacteriologically tested ready-to-eat sauces and salads served together with kebab meat.

Another report from the United Kingdom shows the findings of a local and national survey of the microbiological quality of doner kebab in the first half of the 1990ies and data of an outbreak with *Salmonella mikawasima* due to contaminated doner kebab. The authors of the outbreak investigation came to the conclusion that further studies would be useful to assess the risk of illness in association with consumption of kebab (Pawsey, 2002). Another outbreak caused by *Salmonella typhimurium* DT 170 (Evans et al., 1999) and the present report on cases of SET-intoxications point out to the fact that there are critical

steps in the preparation of doner kebab and that they have to be addressed consequently by kebab take-away restaurants, a conclusion which is clearly strengthened by our findings.

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References

- Baumgartner A. 2008. Gruppenerkrankungen (Ausbrüche) mit mikrobiell kontaminierten Lebensmitteln in der Schweiz, 1994-2006. Bull. FOPH 32: 562-568.
- Dawsey RK. 2002. Case studies in food microbiology for food safety and quality. Cambridge: The Royal Society of Chemistry, pp. 99-109.
- Evans MR, Salmon RL, Nehaul L, Mabl, S, Wafford L, Nolan-Farrell MZ, Gardner, Ribeiro CD. 1999. An outbreak of *Salmonella typhimurium* DT 170 associated with kebab meat and yoghurt relish. Epidemiol. Infect. 122: 377-383.
- Meldrum RJ, Little CL, Sagoo S, Mithani V, McLauchlin J, de Pinna E. 2009. Assessment of the microbiological safety of salad vegetables and sauces from kebab take-away restaurants in the United Kingdom. Food Microbiol. 26: 573-577.
- Murchan S et al. 2003. Harmonization of pulsed-field gel electrophoresis protocols for epidemiological typing of strains of methicillin-resistant *Staphylococcus aureus*: a single approach developed by consensus in 10 European laboratories and its application for tracing the spread of related strains. J. Clin. Microbiol. 4: 1574-1585.

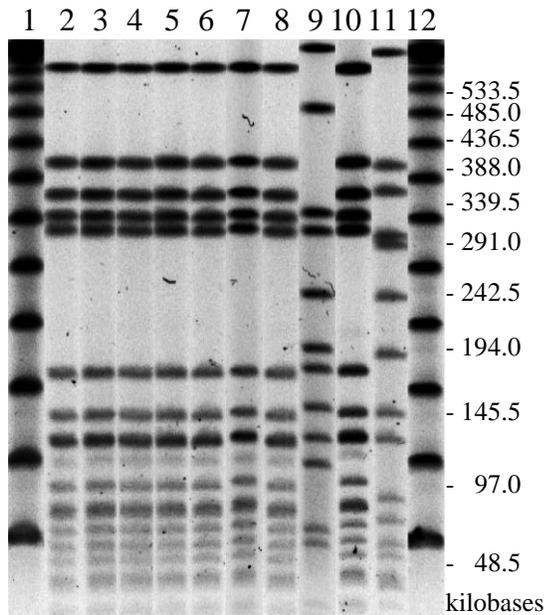


Figure 1: PFGE-profiles from coagulase-positive staphylococci (*S. aureus*) in an outbreak due to contaminated doner kebab.

1: Lambda ladder; 2: Chicken kebab, ready-to-eat from bain-marie; 3: Calf kebab, ready-to-eat from bain-marie; 4: Beef kebab, ready-to-eat from bain-marie; 5: Chicken kebab, raw from spit; 6: Calf kebab, raw from spit; 7: Beef kebab, raw from spit; 8: Canned mushrooms, ready-to-eat; 9: Chicken kebab, raw and pre-packed; 10: Canned corn, ready-to-eat; 11: *S. aureus* NCTC 8325; 12: Lambda ladder