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Cross-contamination during the preparation of frozen chickens in the kitchen

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SUMMARY

A study was made of the extent to which frozen broilers, contaminated with indicator organisms, can cause cross-contamination in the kitchen.

In 60 kitchens a number of relevant objects were sampled during the preparation of contaminated frozen broilers. The results show that cross-contamination occurred in a high proportion of the kitchens examined. In many instances the indicator organism was still present on various objects even after rinsing, 'clearing' or washing up. In view of the possible risk of a cross-contamination with *Salmonella* spp. the importance of instructing food preparers is emphasized.

No salmonellas could be found in the sinks of the 60 kitchens examined.

INTRODUCTION

Broilers are bred, killed and frozen in large numbers. During these processes, particularly at killing, cross-contamination with pathogenic and spoilage micro-organisms occurs. This results in large numbers of contaminated broilers.

Van Schothorst *et al.* (1976) found in frozen broilers a contamination rate with *Salmonella* species varying from 25 to 64%, depending on the sampling method used.

Salmonellas are the most important causative agents of food-borne disease in The Netherlands and, as such, their presence in broilers is undesirable. It is often postulated that these food-borne diseases cannot be caused by eating chickens as these are not eaten raw, and the organisms are killed during cooking. However, contamination of surfaces, hands and other foods in the kitchen can occur during the preparation of raw chickens (Kampelmacher, 1963). This contamination often plays part in the origin of food-borne disease (Sanborn, 1963; Woodburn, 1964; Gilbert, 1969; Todd *et al.* 1970).

Mossel *et al.* (1968) showed that in catering establishments, if one object was contaminated with Enterobacteriaceae, the same organisms were regularly found in other objects in the same kitchen.

The purpose of this investigation was thus to gain insight into the possibility of cross-contamination occurring in the kitchen during thawing and preparation of frozen broilers. To study this possibility, a strain of *E. coli* K12 was applied to the carcasses before they were frozen.

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During an investigation of families in which a baby had salmonellosis the kitchen table, the sink or both were found to be contaminated with salmonellas in 22 of the 76 families investigated (Van Schothorst *et al.* 1978). Because of this, in every family where sampling took place during the preparation of a chicken, the sink was examined for salmonellas.

MATERIALS AND METHODS

The investigated families and the sampling of the kitchens

Before the start of the research, an inquiry was set up into the circumstances and procedures of thawing and preparing frozen broilers.

A questionnaire was sent to 350 randomly chosen families, and replies were received from 180. The families were asked if they would be prepared to cooperate in an investigation involving the preparation of a frozen broiler in their own kitchen, and 60 of the families were willing to participate. A frozen broiler, contaminated with *E. coli* K12, was offered to each of these 60 families, who were asked to thaw and prepare it in their usual way.

Various methods of preparation were used, these included the chicken being rinsed, stripped of the skin, cut or seasoned.

While and just after these actions were performed, several objects were sampled using cotton swabs. Objects were chosen which seemed to be important to prove possible cross-contamination with *E. coli* K12 (see Table 1). After the chicken had been put into the grill, oven, or frying pan to cook, in some of the families the used utensils (knife, plate, strainer, etc.) were well rinsed and then put to be washed up. The kitchen table was then cleared. In these families some samples were taken immediately after this 'clearing'. In other families that did not clear up immediately, samples were taken after the washing-up, often some hours after the preparation of the chicken.

Contamination of the broilers

In the experiments the broilers used were artificially contaminated with a strain of non-pathogenic nalidixic acid-resistant *E. coli* K12. This was achieved by taking chickens, weighing about 1 kg, away from the packing line and plunging them into a water tank which contained a suspension of either $5{\cdot}5 \times 10^4$, or $5{\cdot}5 \times 10^5$ *E. coli* K12 per ml. of water. The chickens were then packed, frozen for 24 h at -40 °C and stored at -20 °C.

During the experiments the numbers of *E. coli* K12 on the broilers were verified continuously. The counts were about 10^2 per ml thaw water (low contamination) and 10^3 per ml thaw water (high contamination).

Determination of E. coli *K12*

To prove the presence of *E. coli* K12 in the cotton swabs after sampling, these were put in tubes with buffered peptone water (10 g peptone, 5 g NaCl, 1·5 g KH_2PO_4, 9 g $Na_2HPO_4.12\,H_2O$ per litre) with 0·01 % nalidixic acid. After 20 h incubation at 37 °C the enrichment cultures were streaked on crystal-violet

Table 1. *Contamination of various objects during the preparation of frozen broilers, contaminated with* E. coli *K*12

Object	Total number of samples	Contaminated samples (%)
Cutting-board	17	100
Item, after rinsing	13	77
Plate, dish, strainer, etc.	29	90
Item, after rinsing	32	72
Grating of sink	54	87
Raised border of sink	49	67
Tap	56	82
Dishcloth	38	74
Kitchen utensils (grips)	81	68
Kitchen table	209	65
Spice-tins, salt-cellar	85	60
Doorhandle, point of contact	67	24
Towel	51	14

neutral-red bile lactose agar (VRBL, Oxoid) with 0·02% nalidixic acid. The plates were read after 24 h incubation at 37 °C for the presence of *E. coli* K12. Sometimes further confirmation was performed with phage λv 15.

The number of *E. coli* K12 in the thaw water was counted on VRBL with 0·02% nalidixic acid.

Salmonella investigation in sinks

To determine the presence of *Salmonella*, the sink was sampled immediately after the broiler was put into the grill, oven or frying pan. The sink and its grating were sampled with a spherical swab with a diameter of about 5 cm. The swab was then put into 200 ml. of buffered peptone water. After 20 h incubation at 37 °C, 10 ml of this pre-enrichment medium was transferred to 100 ml of Muller–Kauffmann enrichment medium. After 24 and 48 h incubation at 43 °C the enrichment culture was streaked on brilliant-green/phenol-red agar (BGA, Oxoid; ISO-3565). The plates were read after 24 h incubation at 37 °C and suspect colonies were biochemically confirmed and serotyped.

RESULTS

The results of the samples taken in the kitchen during the preparation of the frozen broilers are given in Table 1. The objects sampled are divided into 13 categories for sake of clarity. The number of samples taken and the percentage of contaminated samples is given for each category.

Since no significant difference in the percentage of contaminated samples seemed to exist between the kitchens in which broilers with high or low contamination were prepared, the results are given without further classification.

The impression was created that the way of handling the broiler during the preparation was very important for the results. A preparation method that

Table 2. *Contamination of various objects after 'clearing'*

(Number of kitchens examined: 11. Number of kitchens in which *E. coli*-organisms were found after 'clearing': 7.)

Objects	No. found contaminated
Sink (raised border)	7
Grating of sink	5
Kitchen table	5
Dishcloth	4

Table 3. *Contamination of various objects after washing-up*

(Number of kitchens examined: 27. Number of kitchens in which *E. coli* organisms were found after washing-up: 10.)

Objects	No. found contaminated
Dishcloth	7
Kitchen table	5
Cutting board	3
Sink (raised border)	2
Grating of sink	2

needed few actions, for example in a grill or in an earthen pan in the oven, gave few contaminated samples. No clear relation could be found between the contamination of a kitchen table and a sink and the material of which the kitchen table or sink was made.

Immediately after preparation the used utensils were 'cleared' (not washed up) in 11 kitchens. Table 2 lists the results of samples taken after 'clearing'.

In 27 kitchens the survival of the indicator organisms was examined after washing-up. These results are listed in Table 3.

Salmonella was not found in any of the sinks examined.

DISCUSSION

In this experiment it is clearly proved that a broiler contaminated with *E. coli* K12 is able to contaminate a large number of objects. In a number of kitchens, after rinsing and washing-up, the cutting board, sink or dishcloth were still contaminated with *E. coli* K12.

The percentage of towels on which the indicator strain was found was low. This can be explained by the fact that during the examination people were more hygienic than usual and they washed their hands more carefully before using the towel. Besides, the sampling method using swabs is less effective for objects with a rough surface, such as towels.

In the light of these results, it can be concluded that a cross-contamination with *E. coli* K12 could easily occur in these kitchens. The organisms survived for a long period on various surfaces in the kitchen, so that the fried chicken or other food could be contaminated again.

In the experiments described the artificial contamination with *E. coli* K12 was a model for the contamination of broilers with *Salmonella*. To be able to compare the strain of *E. coli* K12 used with *Salmonella*, it has to be taken into account that *Salmonella* can be more resistant to some external circumstances than *E. coli* K12. Some unpublished experiments in this laboratory have shown that *Salmonella* could be isolated from surfaces contaminated with them up to 6 h after the surface had dried. In similar experiments with *E. coli* K12, organisms could be found at 4 h, at most, after the surface had dried.

The fact that *Salmonella* was not found in the sinks is not unusual. The number of kitchens sampled (60) was rather low, salmonellas are distributed irregularly and they are often present in smaller numbers than the numbers of *E. coli* K12 on the carcasses (Surkiewicz *et al.* 1969; Notermans *et al.* 1975). This does not alter the conclusion that broilers, contaminated with *Salmonella*, can cause cross-contamination in the kitchen, and by that can cause food-borne disease when circumstances, such as too long storage at too high a temperature, or insufficient heating, are favourable for the micro-organisms.

Since it is improbable that, in the short term, the degree of contamination with salmonellas will diminish in a number of foodstuffs, the standard of hygiene in the kitchen will remain of the utmost importance in the prevention of salmonellosis in man. More attention therefore has to be given to instructing the consumer (Van Schothorst, Huisman & Os, 1978; Horwitz & Gangarosa, 1976).

During the sampling in the kitchens the idea of 'cross-contamination' and its possible consequences usually appeared to be unknown. Therefore instruction must be given to food-preparers that pathogenic bacteria can be present on raw food. To prevent cross-contamination in the kitchen, raw and cooked foods have to be handled separately. For instance, the same cutting board should not be used for both raw and cooked carcasses, an action often seen, and which in the past has given rise to food-borne disease (Semple, Turner & Lowry, 1968).

Hands and utensils that have come into contact with raw foodstuffs must be well washed. This investigation has proved that after 'rinsing' a lot of the indicator organisms could still be found on the kitchen utensils. To minimize the chance of food-borne disease, these foods must be stored cold and thoroughly cooked before consumption.

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