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PREVALENCE AND CONTROL OF CAMPYLOBACTER JEJUNI IN A TURKEY PROCESSING PLANT

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SUMMARY

The prevalence of Campylobacter jejuni was surveyed from 10 sites in a turkey processing plant. C.jejuni was isolated from 67.7% of the turkey cloacal contents examined. The isolation rate from the defeathering machine in the plant was 4.5% and from the internal cavity of carcasses after evisceration, 32.3%. After spray-cleaning C.jejuni was not isolated from carcasses, nor from any of the remaining sites. It is suggested that contamination of carcasses by C.jejuni was inactivated by spray-cleaning with water containing 40 ppm chlorine. Further, bacterial counts in raw and cooked meat products were all $<10^4$/g. It is concluded that good processing conditions, to yield a product with a total viable count $<10^4$ organisms/g, can prevent the transmission of C.jejuni onto raw meat and cooked meat products.

INTRODUCTION

Campylobacter jejuni is a major cause of enteritis in man and foodborne transmission is one route of infection. Poultry are by far the largest potential source of C.jejuni (1,2). The organism has been isolated from 100% of turkeys and chickens supplying poultry processing plants (3,4). In the present study, equipment, turkeys and meat products were sampled during one month's production at a turkey processing plant. The purpose of this study was to determine the prevalence of C.jejuni and to identify the conditions that would control the spread of the organism during processing.

MATERIALS AND METHODS

The processing plant that was surveyed was part of a fully integrated operation with its own source of turkeys. Birds (24 weeks old) were killed every second day and carcasses were deboned on the second day of the killing cycle. Although conventional slaughtering and processing techniques were used in the plant, personnel were restricted from moving between raw and cooked meat processing areas. Turkeys were stunned once, scalding took place at 60°C for 2 min, and after mechanical defeathering the carcasses entered the evisceration line. The carcasses were opened and the intestines exposed by mechanical means. Following veterinary inspection, intestines and other organs were removed manually. The carcasses were spray-cleaned with water with a total chlorine content of 40 ppm. After chilling , a proportion of the carcasses were packed and frozen at -40°C for 20 h. The frozen carcasses were for retail sale; the remaining carcasses underwent further processing at the plant. The latter carcasses were deboned manually or mechanically. Meat products were prepared and cooked (core temperature of 730-75°C for 20 min). Some of these were packaged and sold as bulk products, while others were sliced and vacuum-packaged for sale at retail outlets.

The types and numbers (in parentheses) of samples taken were as follows: cloacal contents from birds (96); swabs from the defeathering machine (44); swabs from the internal cavity of carcasses after evisceration (96); breast meat (64), swabs from a 25 cm^2 area of skin (44) and swabs from the internal cavity of carcasses (44) after spray-cleaning; deboned meat (64) and swabs of the mechanical deboner (44); packaged, cooked products (201); packaged, sliced, cooked products (72). All sampling and transfers were performed aseptically.

The selective medium used for isolation of C.jejuni was Skirrows' agar (5). Cloacal contents were streaked directly on the surface of the medium. Cotton swabs moistened with brucella broth (Difco) were used to wipe surfaces followed by inoculation of the selective medium by streaking. Meat samples (10 g) were macerated in sterile bags with 90 ml of physiological saline using a Colworth 400 stomacher for up to 5 min. Plates of Skirrows' agar were each inoculated with 0.1 ml of the homogenate. Inoculated plates were incubated at 42°C for 48 h in a microaerobic atmosphere produced in anaerobic jars containing a CampyPak envelope (BBL) and palladium catalyst. Colonies typical of C.jejuni were selected from Skirrows' agar, Gram-stained and examined for Gram-negative spiral-shaped cells. Isolates were confirmed by their catalase and oxidase production, lack of growth at 25°C, sensitivity to nalidixic acid (30ug) and hippurate hydrolysis.

In addition, ten-fold serial dilutions of the meat homogenate (prepared above) were made in saline and plated by the spread technique on plate count agar (Difco). Triplicate plates for each dilution were incubated aerobically at 30°C for 72 h and the total viable count (TVC) of bacteria in each sample was determined.

RESULTS AND DISCUSSION

C.jejuni was isolated from 65 (67.7%) of the turkey cloacal contents examined. This finding is in agreement with previously reported isolation rates of 16-100% (3,6). In general, a considerable variability exists among poultry flocks in carrier status (4). C.jejuni was isolated from 2 (4.5%) of the swabs from the defeathering machine which could act to contaminate non-carrier birds. Furthermore, Acuff et al. (7) found that the extent of C.jejuni contamination on carcasses increased after mechanical deboning. The organism was isolated from 31 (32.3%) of the swabs from the internal cavity of carcasses after evisceration which shows that during this stage of processing spillage of some intestinal material can occur. Oosterom et al. (8) also found that large numbers of C.jejuni were released from intestinal contents during defeathering and evisceration.

C.jejuni has been isolated from raw turkey meat in processing plants by other workers (3,7,9,10,11). After spray-cleaning, however, C.jejuni was not isolated in this study from carcasses i.e. from breast meat, from the skin or from the internal cavity. Yusufu et al. (12) in a similar study isolated C.jejuni from intestinal contents, but not from turkey meat, and presumed this was due to the chilling process, washing with chlorinated water or the presence of low numbers of C.jejuni on carcasses. C.jejuni is inactivated by chlorine and related compounds, and suspensions of the organism do not survive exposure to 10 ppm chlorine for 30 sec (13,14). As the water in the processing plant surveyed contained 40 ppm chlorine, it is suggested that contamination of carcasses by C.jejuni was inactivated by this concentration of chlorine during spray-cleaning.

In addition, the TVCs in raw meat samples were determined (table 1). The numbers of micro-organisms present were greater after the deboning process (7.20×10^3/g) than immediately after the carcasses were spray-cleaned with chlorinated water (1.30×10^3/g). The raw meat examined in this investigation was within the acceptable range of TVC for poultry (15,16).

In contrast to the study of Stern et al. (17) who isolated C.jejuni from fresh deboned chicken meat, the bacterium was not isolated from deboned turkey meat nor from the mechanical deboner in this survey. These findings suggest that hygienic handling procedures for raw meat were in operation in the plant.

Table 1. Total viable count (TVC) in raw turkey meat

Meat sample	Number of samples	Maximum TVC/g sample	Minimum TVC/g sample	Mean TVC in samples/g
Breast meat after spray-cleaning	64	2.50×10^3	1.00×10^2	1.30×10^3
Deboned meat	64	1.20×10^4	1.60×10^3	7.20×10^3

A total of 67 batches of seven packaged, cooked meat products were examined for the presence of C.jejuni and their TVCs were determined (table 2). C.jejuni was not isolated from any of these bulk products. Of those products examined, luncheon meat had the minimum microbial count ($<1.00 \times 10^2$/g), while frankfurters had the maximum count (4.30×10^3/g). Twenty-four batches of six packaged, sliced, cooked meat products were examined in a similar manner (table 3). C.jejuni was not detected in any of the samples. Turkey roll had the minimum (5.00×10^2/g) and roast stuffed turkey the maximum (5.00×10^3/g) microbial count of these sliced products. A direct comparison of the bacterial counts for the same type of product in tables 2 and 3 is not possible as the batches of bulk and sliced products differed. The TVCs of packaged products, however, supports the conclusion that hygienic handling procedures were in operation in the plant.

The variation in TVC in cooked meat products (unsliced and sliced) is due to their ingredients as all products undergo a similar cooking process and similar handling procedures. Frankfurters are composed mainly of comminuted meat which may contain as many as 5×10^6 organisms/g of meat before cooking (18). Stuffings, flavourings and spices also add to the bacterial load

Table 2. Total viable count (TVC) in bulk products

Product	Number of batches	Number of samples	Maximum TVC/g sample	Minimum TVC/g sample	Mean TVC in samples/g
Frank-furter	14	42	5.00×10^3	1.70×10^3	4.30×10^3
Roast turkey breast	29	87	7.00×10^2	$<1.00 \times 10^2$	2.00×10^2
Roast stuffed turkey	7	21	3.00×10^3	9.00×10^2	1.60×10^3
Smoked turkey ham	5	15	5.00×10^2	2.00×10^2	3.00×10^2
Luncheon meat	5	15	1.00×10^2	$<1.00 \times 10^2$	$<1.00 \times 10^2$
Garlic salami	5	15	1.50×10^3	1.50×10^3	1.50×10^3
Turkey roll	2	6	1.00×10^2	1.00×10^2	1.00×10^2

of the products (15).

C.jejuni is heat sensitive and is inactivated by pasteurization at 63°-64°C for 30 min (19). Stern & Kotula (20) reported that 10^7 cells of C.jejuni/g were inactivated within 10 min after ground meat reached an internal temperature of 70°C. Therefore, the cooking process (core temperature of 73°-75°C for 20 min) in the plant was adequate to inactivate C.jejuni.

Table 3. Total viable count (TVC) in sliced product

Product	Number of batches	Number of samples	Maximum TVC/g sample	Minimum TVC/g sample	Mean TVC in samples/g
Roast turkey breast	6	18	1.20×10^3	7.00×10^2	9.50×10^2
Roast stuffed turkey	6	18	9.00×10^3	1.00×10^3	5.00×10^3
Smoked turkey ham	6	18	3.80×10^3	5.00×10^2	2.20×10^3
Luncheon meat	2	6	1.60×10^3	1.00×10^2	8.50×10^2
Garlic salami	2	6	4.00×10^3	1.50×10^3	2.80×10^3
Turkey roll	2	6	9.00×10^2	1.00×10^2	5.00×10^2

Turnbull & Rose (21) found an association between a high percentage of C.jejuni isolations and a high TVC (>10 organisms/g) in meats. The findings of the present study show that good processing conditions, to yield a product with a TVC $<10^4$ organisms/g, can prevent the transmission of C.jejuni onto raw meat and cooked meat products. The following recommendations are made to control the transmission of C.jejuni onto meat during poultry processing:

(a) frequent examination of the defeathering machine to prevent cross-contamination;
(b) careful control of the evisceration process to prevent spillage of intestinal contents;
(c) water with a total chlorine content of 40 ppm or greater to be used in the spray-cleaning of carcasses;
(d) movement of personnel between raw and cooked meat areas within the plant to be restricted and hygienic handling procedures to be enforced;
(e) a cooking process which is at least equivalent to pasteurization to be used in processing.

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