Incidence of *Campylobacter* in Crops of Preharvest Market-Age Broiler Chickens[1]

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ABSTRACT Previous research has identified cecal and intestinal contents as sources for *Campylobacter* contamination of broiler carcasses in the processing plant. During the present study, we evaluated the crop contents of preharvest market-age broilers as a potential reservoir of field-derived *Campylobacter* in the processing plant. Crops were collected aseptically from 40 randomly selected market-age broilers in each of nine commercial broiler flocks. Ceca were collected from broilers in six of the same flocks for comparison with the crop samples. The presence of *Campylobacter* in the crops and ceca was determined by enrichment culture in Bolton broth followed by culture on Campy-Ceflex plates. *Campylobacter* was isolated from the crop contents of broilers in seven of the nine flocks and from the cecal contents in three of six flocks. The incidence of *Campylobacter*-positive crop samples among all birds evaluated (224/359; 62%) was significantly higher ($P < 0.001$) than the number of positive cecal samples (9/240; 4%). The results indicate that the incidence of *Campylobacter* contamination of crop contents may exceed that of the cecal contents by as much as 37-fold in some broiler flocks, and may represent a critical preprocessing control point in reducing *Campylobacter* entry into the processing plant.

(*Key words*: *Campylobacter*, crop, ceca, contamination, feed withdrawal)

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INTRODUCTION

Campylobacter is reported to be the most frequent cause of human foodborne illness in the U.S. (FSIS/CDC/FDA, 1997) and to cost consumers one billion dollars annually (Buzby *et al*., 1996). Poultry products have been identified as a major source of human campylobacteriosis (Tauxe, 1992; Harris *et al*., 1986). *Campylobacter* contamination of processed broiler carcasses was reported to range from 7 to 32% during the winter months and from 87 to 97% during the summer months (Willis and Murray, 1997). The source contamination has been attributed to the entry of *Campylobacter* into the processing plant in the intestinal tracts of asymptomatic broilers and the subsequent contamination of equipment and cross-contamination of during processing (Prescott and Munroe, 1982; Oosterom *et al*., 1983; Shanker *et al*., 1992).

Because intestinal contents have been considered to be the primary source of *Campylobacter* entry into the processing plant, researchers have focused on determining the incidence and population of the bacterium in the cecal contents and cloaca. It was recently reported that, although the ceca is also the primary site of *Salmonella* colonization of poultry, contamination rates are equal or frequently higher in the crop contents of broilers during processing than in the ceca (Hargis *et al*., 1995). Mead and co-workers (1995) reported that the neck flaps collected at exsanguination during processing were all *Campylobacter*-positive. Furthermore, *Campylobacter* counts were higher on the breast tissue of broiler carcasses than on the thigh or drum stick (Kotula and Pandya, 1995). The high incidence of contaminated neck flaps and breast tissue suggest that, similar to *Salmonella*, crop contents may be an important source of *Campylobacter* contamination during processing. The purpose of the present study was to determine the incidence of *Campylobacter* in the crop and ceca of market-age broilers on commercial broiler farms and to further evaluate the crop as a reservoir of field-derived *Campylobacter* in the processing plant.

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MATERIALS AND METHODS

Campylobacter *in Crops and Ceca*

To compare the incidence of *Campylobacter* in the crop with that in the ceca prior to processing and to determine

TABLE 1. Incidence of *Campylobacter* in the crops and ceca of preharvest market-age broiler chickens prior to transport

Broiler flock	Length of feed withdrawal	*Campylobacter* presence	
		Crop	Ceca
	(h)	[positive/total (%)]	
1	2	0/40 (0)	0/40 (0)
2	4	0/40 (0)	0/40 (0)
3	5	13/40 (32.5)**	2/40 (5.0)
4	7	38/40 (95)***	0/40 (0)
5	8	37/40 (92.5)***	1/40 (2.5)
6	8	40/40 (100)***	6/40 (15.0)
7	8	36/40 (90)	ND[1]
8	8	30/39 (76.9)	ND
9	8	30/40 (75)	ND
Total		224/359 (62..4)***	9/240 (3.8)

[1]ND = not done.

**Significant ($P < 0.005$) differences in positive/total crop and ceca collected from chickens in a given broiler flock.

***Significant ($P < 0.001$) differences in positive/total crop and ceca collected from chickens in a given broiler flock.

whether crops may serve as a reservoir of field-derived *Campylobacter*, crops were collected aseptically from 40 randomly selected broilers in each of nine broiler flocks immediately before the birds were crated for transport to the processing plant. The birds in broiler rearing house were allowed free access to water and were subjected to a feed withdrawal ranging from 2 to 8 h as determined per standard operating procedure of the commercial production unit (Table 1). At the termination of the experiment, broilers were killed by cervical dislocation. The ceca were collected from broilers in Flocks 1 to 6. Each crop was incised aseptically and both ceca were cut into several equal sections and placed in separate Whirl-pac®[3] bags. All samples were placed in ice chests that were maintained at 4 C during transport to the laboratory for culture.

Bacteriological Analysis

All samples were cultured for *Campylobacter* immediately upon arrival at the laboratory and within 24 h after collection. Flocks 1, 2, and 3 were simultaneously processed. Similarly, Flocks 4, 5, and 6 and 7, 8, and 9 were processed on the same day. Upon arrival at the laboratory, 10 mL of sterile distilled water was added to each bag containing the crop from each bird and was stomached[4] for 30 s. Two mL of the stomached material was transferred to 20 mL of a modified Bolton broth (Musgrove *et al*., 1997) and incubated for 4 h at 37 C, followed by 20 h at 42 C in a microaerobic environment (5% O_2, 10% CO_2, 85% N_2). Each cecum was excised aseptically into 20 mL of Bolton broth and incubated for 4 h at 37 C and followed by incubation for 20 h at 42 C in a microaerobic environment. Following Bolton broth enrichment, samples were streaked for isolation on Campy-Ceflex plates (Stern *et al*., 1992) and incubated for 24 to 48 h at 42 C in the microaerobic environment described above. Suspect *Campylobacter* colonies were confirmed serologically using a latex-agglutination kit specific for *Campylobacter jejuni*, *Campylobacter coli*, and *Campylobacter lari*.[5]

Statistical Analysis

Differences in the number of *Campylobacter*-positive crops and ceca at broiler rearing houses were analyzed by chi-square analysis (Luginbuke and Schlotzhauer, 1987).

RESULTS AND DISCUSSION

Transportation from the farm to the processing plant has been shown to increase *Campylobacter* contamination of the external surfaces of market-age broilers due to defecation and the resulting fecal contamination (Stern *et al*., 1995). *Campylobacter* contamination of broiler carcasses has previously been attributed to the leakage of gastrointestinal tract contents during processing (Prescott and Munroe, 1982; Shanker *et al*., 1982, 1992; Oosterom *et al*., 1983). However, a recent study of *Salmonella* contamination has shown that greater than 50% of crops from market-age broilers were *Salmonella*-positive compared to 15% of the ceca (Hargis *et al*., 1995). Due to the higher *Salmonella* contamination rates of the crop vs the ceca, we investigated the incidence of *Campylobacter* in the crops and ceca of preslaughter market-age broiler chickens prior to capture and transport to the processing plant. The relative potential of the crops and ceca to serve as a source of *Campylobacter* carcass contamination was determined by sampling a total of 359 crops and 240 ceca from broilers in nine commercial rearing houses (Table 1). The incidence of crops positive for *Campylobacter* was significantly greater ($P < 0.005$) than the incidence of positive ceca in Flocks 3 to 6 and no *Campylobacter* were detected in Flocks 1 and 2. Although *Campylobacter* comparisons were not made between crop and ceca in Flocks 7 to 9, a high percentage (75 to 90%) of the crops were *Campylobacter*-positive. The total incidence of *Campylobacter*-positive crops was significantly greater ($P < 0.001$) (224/359; 62.4%) than the total incidence of *Campylobacter*-positive ceca (9/240; 3.8%).

The major source of human campylobacteriosis has been identified as *Campylobacter* contamination of poultry and poultry products (Tauxe, 1992). The contamination of broilers during processing is due to rupture of the gastrointestinal tract during evisceration (Harris *et al*., 1986; Izat *et al*., 1988). *Campylobacter* counts were found to be higher on the breast and neck flap than on the thigh or drum stick of processed broiler carcasses (Kotula and Pandya, 1995; Mead *et al*., 1995). The higher *Campylobacter* contamination on the breast

[3]Nasco, Ft. Atkinson, WI 53583.
[4]Teckmar Stomacher 80, Laboratory Blender, Cincinnati, OH 45242.
[5]INDX-CAMPY (JCL)™, Integrated Diagnostics, Inc., Baltimore, MD 21227.

area of carcasses corresponds with observations by Hargis *et al.* (1995) that the crop was far more likely to rupture than the ceca during the evisceration process. The present study was to determine whether the crop is a source of *Campylobacter* contamination in market-age broilers sampled prior to transport to the processing plant. It was demonstrated that *Campylobacter* contamination of crop contents is significantly higher than cecal contents in preharvest broilers prior to capture and transport to the processing plant. It is interesting that *Campylobacter* was not isolated from crops in Flocks 1 and 2 in the present study. These flocks experiencing the shortest feed withdrawal times evaluated (2 or 4 h). Although representing a small sample size, these data suggest that prolonged feed withdrawal is associated with an increase in crop contamination by *Campylobacter*, as has been shown for *Salmonella* (Rameriz *et al*., 1997). These results indicate that the incidence of *Campylobacter* in the crops of market-age broilers at the time of transport may be an important critical control point for reducing *Campylobacter* entry into the processing plant, ultimately reducing contamination of broiler carcasses.

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