CONTAMINATION OF BROILER CHICKEN CARCASSES
BY THERMOTOLERANT CAMPYLOBACTER SP.
AT SELECTED STAGES OF SLAUGHTER

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Abstract

The conducted study was aimed at determining the level of contamination of broiler chicken carcasses by Campylobacter sp. at selected stages of post-slaughter processing: after defeathering, evisceration, washing, and chilling. Swabs were collected from a 20 cm² skin surface from the neck and cloacal areas and from the wall of the body cavity. The swabs were fixed in flat-bottom flasks with 20 ml of sterile diluent. The resultant suspension was inoculated into two parallel Petri dishes with selective culture media: Karmali agar and CCDA agar. The analyses demonstrated that during the processing, Campylobacter sp. was disseminated on the surface of broiler chicken carcasses. The highest contamination of the carcasses, reaching on average log 1.71 cfu/cm² was observed after their evisceration, especially on skin in the neck area – log 1.96 cfu/cm². In the washed carcasses, the cell count of Campylobacter decreased to a value of log 0.45 cfu/cm². A similar degree of contamination, i.e. log 0.38 cfu/cm², was recorded after chilling.

Key words: broiler chicken carcasses, Campylobacter, contamination, processing.

Campylobacteriosis is a typical zoonosis induced by thermotolerant bacteria of the genus Campylobacter. In the case of humans, infections are induced as a result of the uptake of live cells of those bacteria with food. An infectious dose for humans is relatively low, less than 1,000 cfu; therefore, the infections in humans are relatively common and easy to occur (3).

Epidemiological surveys indicate that Campylobacter sp. is currently the most frequently identified human enteropathogen (annually ca. 400 billion of infections worldwide), and that in recent years the number of infections has increased drastically in many countries (6). In the case of alimentary infections, Campylobacter sp. is isolated 3–4 times more often than other enteropathogens, namely such bacteria as Salmonella or E.coli. In a recent study conducted by Jacobs–Reitsma (5), Salmonella sp. was isolated in 27%, whereas Campylobacter sp. – in as many as 82% of poultry intestines.

In the case of humans, the major sources of infections with the strains of Campylobacter include animals, food, as well as the environment (soil and water). Extensive occurrence of Campylobacter sp. in the animal population poses a risk of contamination of food products, including raw meat, fresh raw milk, and water (13). In addition, birds are one of the most significant reservoirs of Campylobacter sp. These bacteria have been demonstrated to be a constituent of bacterial intestinal flora of chickens, turkeys, geese, ducks, as well as game and wild fowls. The presence of Campylobacter sp. may be accompanied, though relatively seldom, by symptoms manifested in the alimentary tract. Healthy birds may excrete ca. 10⁵–10⁷ of bacteria/g with faeces (12). Slaughtering, after-slaughter handling, and processing of poultry on a commercial scale significantly facilitate the contamination of carcasses, even those initially free of these bacteria (2). As it was demonstrated so far, the concentration of Campylobacter sp. on the surface of birds’ skin transported to a slaughterhouse ranges approximately from 1 to 5.5 cells/cm² (4). In a study by Kwiatek et al. (9), the frequency of isolation of these bacteria was at 80.3% level, Atanassova and Ring (1) demonstrated that 51 out of 111 samples were Campylobacter–positive, which constituted 45.9% of all samples. However, other authors demonstrated that the contamination of broiler carcasses with Campylobacter sp. ranged from 0% to 100% (7, 8).

The study was undertaken to determine the influence of selected stages of slaughter on the degree of the contamination of broiler chicken carcasses.
Material and Methods

The carcasses of broiler chickens were the material for a bacteriological analysis of their contamination with *Campylobacter* sp. At the selected stages during slaughter, i.e. defathering, evisceration, washing, and chilling, swabs were collected from a 20 cm² skin surface from the neck and cloacal areas, and from the wall of body cavity, delimited by a sterile template and sterile swabs (Copan Italia). On each stage, five carcasses were taken for bacteriological examination. The examination was repeated 10 times. The total 200 carcasses were examined. Immediately after the collection, the swabs were transported to a laboratory under refrigeration conditions (a thermal bag with a cooling agent). In the laboratory, the swabs were immediately fixed in flat-bottom flasks with 20 ml of sterile diluent, and mixed thoroughly by shaking for 2 min. The resultant suspension was inoculated directly onto two parallel Petri dishes of ø 140 mm (1 ml on each) with selective culture media: Karmali agar (Oxoid) and CCDA agar (Oxoid) that had earlier been pre-dried to remove water condensate and to enable the absorption of the suspension. After incubation under microaerophilic conditions (85% N₂, 10% CO₂, 5% O₂) at 42°C for 44 h ± 4 h, the number of grown bacterial colonies, which supposedly belonged to the genus *Campylobacter* were counted. Affiliation to the genus *Campylobacter* was confirmed by analyses of morphological traits, motion capacity, and production of oxidase.

The results are presented as the bacterial cell count per 1 cm² of the surface of broiler chickens carcasses. All statistical calculations were performed on logarithmic values. The significance of differences in the bacterial cell count in particular experimental series was evaluated with the Tukey’s test.

Results

The results of bacteriological analyses are presented in the form of diagrams in Figs 1–3. The differences in bacterial cell count on broiler chicken carcasses among particular stages of slaughter were found significant at P≤0.05. Since the logarithm of the bacterial cell count obtained on both culture media used in the study did not display any statistically significant differences (P>0.05), the results were averaged.

Analyses of the samples containing *Campylobacter* sp. after defathering demonstrated the contamination of the skin from the neck area (Fig. 1) at a level of log 1.53 cfu/cm² (range from log 0.39 to log 2.14 cfu/cm²). After evisceration, the level of contamination on the surface of carcasses was observed to increase to an average value of log 1.96 cfu/cm², with the values ranging from log 0.97 to log 2.49 cfu/cm². The washing of the carcasses caused a decrease in the contamination level by one logarithmic cycle to an average value of log 0.39 cfu/cm². The level of contamination after chilling was approximate to those observed after the washing and reached log 0.30 cfu/cm².

Fig. 2 depicts the level of contamination of skin surface at the cloacal area of chicken carcasses after defathering, evisceration, washing, and chilling. Amongst the positive results, the average values accounted for: log 1.65, log 1.78, log 0.43, and log 0.39 cfu/cm², respectively. The obtained results reflected the level of contamination of skin surface of the back.

The contamination of body cavity is shown in Fig. 3. As compared to the contamination level of skin in the neck and cloacal area, on the surface of 1 cm² of the wall of body cavity, the samples with detected *Campylobacter* sp. were characterised by a lower number of these bacteria after the stage of evisceration, i.e. log 1.43 cfu (from log 0.50 to log 2.08 cfu). After the washing and chilling, the number of these bacteria was decreased by one logarithmic cycle, namely to a value of log 0.54 and log 0.47 cfu/cm², respectively. This level of contamination was higher comparing to the results obtained on the other surfaces of carcasses in the other experimental series.

The analysis of the results demonstrated statistically significant differences (P≤0.05) in the contamination of the carcasses between the experimental series after the defeathering, evisceration, and washing. In turn, significant differences were not observed after chilling of the carcasses (P>0.05).

Discussion

The conducted study demonstrated that *Campylobacter* sp. was disseminated on the surface of broiler chicken carcasses during slaughter. An in-depth analysis of the results obtained in the reported study, it was shown that the number of cells of *Campylobacter* sp. on the surface of skin at neck area was accounted for log 1.53 cfu/cm² on average, whereas immediately after evisceration, it was observed to increase by log 0.40 cfu to a value of log 1.96 cfu/cm². A similar tendency was also observed by Rosenquist et al. (11), who reported an increase in the concentration of *Campylobacter* sp. after evisceration in samples from the back of broiler carcasses by log 0.50 cfu, i.e. from log 1.90 cfu/g after plucking to log 2.40 cfu/g after evisceration. According to these authors, chilling of carcasses caused a reduction in the cell count in skin samples to a level of log 1.43 cfu/g, which, compared to contamination level of the carcasses after the evisceration, constituted a decrease by log 0.97 cfu/g. In the current study, the reduction appeared to be greater, i.e. by log 1.48 cfu/cm² on average. Similar results were described by Oosterom et al. (10) as well as by Yogasundram and Shane (14). In their studies, the reduction was accounted for one or two logarithmic cycles; however, they emphasised that the bacteria remaining on carcasses are likely to survive chilling periods for a few months.
Fig. 1. Effect of post-slaughter processing on the contamination of skin in the neck area of broiler chicken carcasses.

Fig. 2. Effect of post-slaughter processing on the contamination of skin in the cloacal area of broiler chicken carcasses.

Fig. 3. Effect of post-slaughter processing on the contamination of the wall of the body cavity of broiler chicken carcasses.
In the current study, the level of contamination of skin surface in the cloacal area of broiler chicken carcasses reached log 1.65 cfu/cm\(^2\) after plucking, whereas no statistically significant differences (P>0.05) were noted after evisceration when the cell count reached log 1.78 cfu/cm\(^2\). This may result from the efflux of intestinal contents during defeathering. Oosterom et al. (10), analysed the level of contamination in 1 g of skin from cloacal area, which after defeathering and evisceration, was accounted for log 1.97 cfu/g and log 2.54 cfu/g, respectively. This indicated that the number of Campylobacter sp. cells increased by log 0.57 cfu/g. The results obtained in the reported study also indicate a decrease in the level of contamination of skin in the neck area after chilling, with the reduction in bacterial cell count being greater compared to the results of studies conducted by Oosterom et al. (10). They reported contamination at a level of log 1.35 cfu/g, whereas in the present study showed a decrease in carcasses’ contamination to a level of log 0.39 cfu/cm\(^2\).

The highest level of broiler carcasses contamination after chilling, i.e. log 0.47 cfu/cm\(^2\), was noted on the surface of the wall of body cavity. In contrast, on the skin in the neck and cloacal areas, the level of contamination reached log 0.30 cfu/cm\(^2\) and log 0.39 cfu/cm\(^2\), respectively. According to Jones et al. (7) as well as Karib and Seeger (8), the presence of Campylobacter sp. in the body cavity of carcasses has, most likely, the greatest risk of infections with these bacteria because the internal temperature of a product subjected to thermal treatment usually does not reach a value that assures neutralisation of this pathogen.

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References