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## Research Note

# Kitchen Practices Used in Handling Broiler Chickens and Survival of *Campylobacter* spp. on Cutting Surfaces in Kampala, Uganda

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## ABSTRACT

Cross-contamination during food preparation has been identified as an important factor associated with foodborne illnesses. Handling practices used during preparation of broiler chickens in 31 fast-food restaurants and 86 semisettled street stands (street vendors) were assessed by use of a standard checklist. These establishments used wood, plastic, or metal cutting surfaces during the preparation of broiler chickens. The survival of *Campylobacter* spp. on kitchen cutting surfaces was determined by inoculating approximately $10^6$ CFU of *Campylobacter jejuni* onto sterile plastic, wooden, and metal cutting boards. The concentrations of the organisms were then assessed in triplicate on each type of cutting board over a 3-h period using standard microbiological methods for thermophilic *Campylobacter* spp. In 87% of food establishments, the same work area was used for preparation of raw and cooked chicken, and in 68% of these establishments the same cutting boards were used for raw and cooked chicken. None of the establishments applied disinfectants or sanitizers when washing contact surfaces. *Campylobacter* spp. survived on wooden and plastic but not on metal cutting boards after 3 h of exposure. The handling practices in food preparation areas, therefore, provide an opportunity for cross-contamination of *Campylobacter* spp. to ready-to-eat foods.

*Campylobacter* species are significant causes of human enteritis worldwide *(2, 22, 27.)* Poultry is believed to be a significant reservoir of *Campylobacter* spp. *(3, 14),* and consumption of poultry has been consistently implicated in the majority of *Campylobacter* infections *(9, 17, 20).* A number of foodborne illnesses in homes and food service establishments are believed to be caused through cross-contamination *(5, 15),* and consumption of chicken prepared in commercial food outlets has been cited as a risk factor for campylobacteriosis *(10).* Because *Campylobacter* species are sensitive to environmental stresses *(18),* are inactivated by cooking temperatures *(4),* and are incapable of growing on cooked meats *(13),* the reported high incidence of *Campylobacter* infections can be attributed to cross-contamination from raw poultry *(30).*

The significance of cross-contamination of *Campylobacter* spp. will depend on how long *Campylobacter* spp. can survive on contaminated surfaces. In this study, we assessed the handling practices used during preparation of raw chicken in commercial food establishments and determined the time of survival of *Campylobacter* spp. on contaminated kitchen cutting surfaces.

## MATERIALS AND METHODS

**Study establishments and handling practices.** Two types of food preparation establishments were studied: fast-food restaurants commonly called take-aways and semisettled street stands also known as street food vendors. These establishments are popular places for eating chicken and are frequented by the majority of the population in Kampala City, Uganda.

The process through which chicken is prepared in take-away restaurants and semisettled street stands was observed and recorded. The handling practices employed during preparation of raw chicken in all the selected food establishments were objectively verified by use of a standard checklist (Table 1) to minimize bias. The type of cutting boards used in handling raw and cooked chicken in the various establishments was noted.

**Survival of *Campylobacter jejuni* on kitchen cutting surfaces.** Survival of *C. jejuni* was studied experimentally on wooden, metal (stainless steel), and plastic (polyethylene) cutting board surfaces commonly used in commercial and domestic kitchens. The experiment was replicated three times, each lasting over a 3-h period. The time duration was appropriate for these experiments because 3 h is the average time during which a bird is portioned, cooked, and made ready for consumption in the majority of commercial food establishments in Kampala.

**Preparation and inoculation of the cutting boards.** *C. jejuni* (ATCC 29428, MicroBiologics, St. Cloud, Minn.) strains were used in the survival study. *C. jejuni* organisms were rehydrated according to the manufacturer's instructions. For primary growth, rehydrated organisms were streaked on nonselective chocolate agar (Que-Bact, Quelab Laboratories, Montreal, Canada) and incubated at 35°C for 72 h in a microaerophilic atmosphere (CampyPak Plus Microaerophilic System with Palladium Catalyst, Becton Dickinson Microbiology Systems, Sparks, Md.). The stock

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TABLE 1. *Handling practices used during chicken preparation in fast-food restaurants*

| Practice | % establishments using practice ($n$ = 31) |
|---|---|
| Knives not washed in hot water and disinfectant | 100 |
| Cutting boards not washed in hot water and disinfectant | 100 |
| Hands of personnel not dried after washing | 90.3 |
| Personnel not separated by work responsibility | 87.1 |
| Work area for raw same as for RTE chicken[a] | 87.1 |
| Same knives used on raw and RTE chicken | 70.9 |
| Cutting surfaces for raw same as for RTE chicken | 67.8 |
| Hands of personnel not washed with water and soap | 29.1 |
| Knives and cutting boards not washed after handling raw chicken | 0 |

[a] RTE, ready to eat.

culture used in the experiments was made by growing isolated colonies from the primary growth in 50 ml of *Brucella* broth (Quelab) supplemented with 0.025% ferrous sulphate, 0.025% sodium metabisulphate, and 0.025% sodium pyruvate (FBP) and incubated at 42°C for 24 h under microaerophilic conditions. To determine the concentration of *C. jejuni* used in the experiment, appropriate 10-fold dilutions of the stock culture were made in *Brucella* broth, and 1 ml of each dilution was surface plated in duplicate on Preston agar (Quelab) and incubated microaerophilically at 42°C for 24 h. The number of *C. jejuni* colonies on Preston agar times the dilution factor was taken as the concentration of *C. jejuni* per ml at that dilution of *Brucella* broth used. The dilution corresponding to $10^6$ CFU/ml was used for subsequent inoculation of the cutting boards.

The cutting boards used in the study were obtained from take-away restaurants. The cutting surfaces were divided into 12 equal squares (25 $cm^2$) using indelible ink *(1).* Wooden and metallic cutting surfaces were sterilized by autoclaving (Prior Clave, London) at 121°C for 15 min. The plastic boards were washed with soap and water, sanitized using a 70% solution of ethanol, and rinsed with distilled water. One milliliter of chicken fluid from a *Campylobacter*-negative bird was applied to each surface square prior to inoculation with approximately $10^6$ CFU/ml *C. jejuni* (ATCC 29428) strains. The chicken fluid was added to simulate natural contamination conditions, which occur when a raw contaminated bird is handled on the cutting boards. Samples were taken from each of the squares every 30 min for 3 h using a sterile swab *(16).* The swabs were placed in sample bottles containing 9 ml of *Brucella* broth supplemented with FBP *(12).*

**Microbiological analysis.** The swab samples were pre-enriched/resuscitated *(29)* in *Brucella* broth containing FBP *(12)* in loosely capped swab bottles at 37°C for 2 h under microaerophilic conditions. Serial dilutions of the resuscitated samples were made using 9 ml of *Brucella* broth containing FBP *(12).* Direct selective plating *(19, 26)* of 0.1 ml of the appropriate dilution of the preenrichment was made on *Campylobacter* Preston agar containing activated charcoal (4 g $liter^{-1}$), growth factor (FBP), and cefoperazone as the antibiotic. Inoculated plates were incubated at 42°C for 48 to 72 h under microaerophilic conditions. Characteristic colonies were tested for motility, morphology, and Gram staining *(21).* Colonies that exhibited characteristic morphology, motility, and Gram stain characteristics consistent with *Campylobacter* spp. were subcultured on blood agar and then tested for growth at 25°C, catalase reaction, oxidase activity, and reaction on triple sugar iron agar *(21).*

## RESULTS AND DISCUSSION

**Preparation practices in semisettled street stands.** All 86 semisettled street stands visited exhibited similar handling practices with respect to roasting of chicken. These food establishments have a small preparation area that is limited to one wooden worktable or metal stand plus a charcoal oven. One individual is responsible for preparation, handling, and roasting of the raw chicken and for serving the ready-to-eat (RTE) chicken portions. Preparation and portioning of the raw chicken is done on the same worktable that is also used to handle the RTE chicken. Roasting is a continuous process that results in simultaneous handling of raw and RTE chicken. The roasted RTE chicken is placed on the same table work surface in close proximity to the raw chicken pieces. However, none of vendors were observed washing their hands after handling raw chicken and before handling the RTE chicken.

The semisettled street establishments lacked basic sanitary amenities such as piped water, warm water, disinfectants, and sometimes plates to hold RTE chicken separately. The vendors do not wash their work areas frequently. The contact surfaces such as the work tables and knives were washed at the end of the day. Unhygienic food preparation practices and lack of basic sanitation facilities such as piped water have been cited among risk factors important for acquiring campylobacteriosis in developing countries *(8).* Cross-contamination in food establishments can be minimized or avoided by having physically separate work areas for raw and cooked foods, frequent washing of contact areas, and washing hands thoroughly after handling raw foods *(11).*

**Handling practices in take-away restaurants.** Practices employed during preparation of raw chicken in 31 take-away restaurants are presented in Table 1. Only 13% of the establishments studied had physically separate work areas for handling raw and cooked chicken, i.e., separate rooms for preparing raw and cooked foods.

Although contact surfaces such as hands, cutting boards, and knives were washed after handling raw chicken, none of the restaurants used hot water or a disinfectant to clean contact surfaces. Although 71% of the workers used

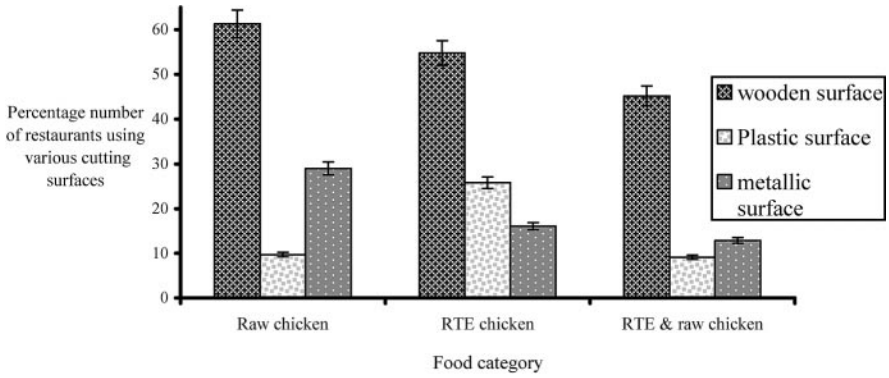


FIGURE 1. *Cutting surfaces used in fast-food restaurants during preparation of chicken.*

soap and water to wash their hands, 29% used cold water without any detergent to clean their hands. Drying of hands with a clean dishcloth after hand washing was observed in 9% of the establishments and, therefore, was not a common practice. Cogan and coworkers *(7)* and Montville and coworkers *(24)* demonstrated the effectiveness of disinfectants in bacterial decontamination of hands and work surfaces. Drying of washed hands has been found to decrease the concentration of bacteria on hands *(6, 24).*

Cutting surfaces that were commonly employed in restaurants for handling and portioning of chicken consisted of plastic (polyethylene) boards, metal (stainless steel) trays, and wooden boards (Fig. 1). The majority of the 31 restaurants studied used wooden cutting boards for both raw (61%) and RTE (51.7%) chicken. Use of same contact surfaces for raw and cooked chicken was a common practice in take-away restaurants. Twenty-one take-away restaurants (68%) used the same cutting board and 22 (71%) used the same knife for portioning raw and RTE chicken. Wooden cutting boards were the most commonly used surface (45%) in restaurants that used same cutting board for raw and RTE chicken, followed by metal (13.7%) and plastic (9%) cutting surfaces.

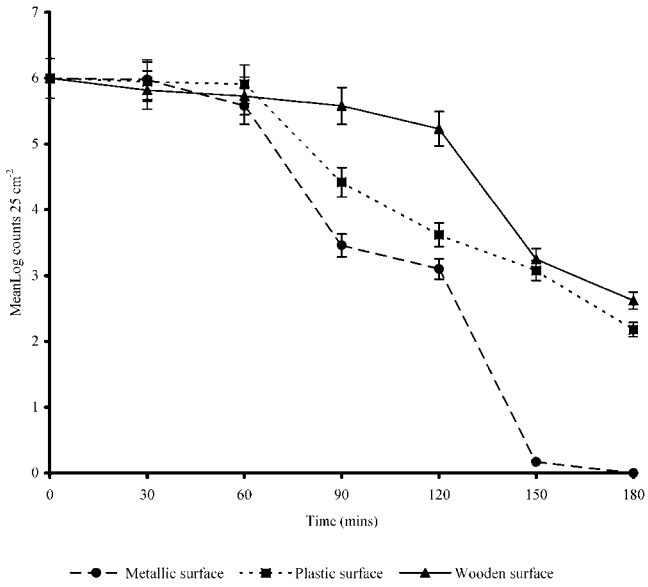


FIGURE 2. *Survival of Campylobacter jejuni on different cutting boards.*

**Survival of *C. jejuni* on kitchen cutting surfaces.** The survival of *C. jejuni* on different cutting surfaces commonly used in commercial and domestic kitchens is presented in Figure 2. Generally, the concentration of *C. jejuni* decreased on all surfaces with time.

There was no marked reduction in the concentration of *C. jejuni* on all study surfaces during the first hour of exposure. However, after the first hour, *C. jejuni* levels did not drop significantly ($P < 0.05$) on wooden boards compared with plastic and metal boards (Fig. 2).

The results showed that *C. jejuni* cells were able to survive longer on wooden and plastic cutting boards than on metal surfaces. Overall, *C. jejuni* levels were significantly lower at each sampling point on the metal surfaces followed by plastic surfaces and then by wooden surfaces ($P < 0.05$). After 2 h of exposure, reductions in *C. jejuni* levels by 3 log cycles and 2.4 log cycles were achieved for metal and plastic surfaces, respectively. However, only 1 log cycle reduction was achieved on wooden surfaces within the same time period. After 3 h of exposure, *C. jejuni* was almost undetectable (1.0 CFU/25 cm$^2$) on metal surfaces, whereas mean counts of $2.2 \pm 0.08$ log CFU/25 cm$^2$ and $2.6 \pm 0.06$ log CFU/25 cm$^2$ were detected on plastic and wooden boards, respectively.

The concern with these survival times in kitchens is the cross-contamination of these organisms to foods, such as raw vegetables, that will not be cooked before consumption. Wooden surfaces have long been discouraged for use in domestic kitchens (particularly for foods of animal origin) because of their ability to retain microorganisms *(28).* Plastic boards are recommended as a sanitary alternative to wooden boards in kitchens *(23, 28).* However, this study has revealed that, like wooden boards, plastic boards can retain *Campylobacter* spp. for a relatively long time.

The survival of *C. jejuni* on cutting surfaces clearly indicates that the potential for cross-contamination in kitchens as a serious problem. Chicken in most fast-food restaurants is prepared and consumed within 3 h. Therefore, when broiler chickens in Uganda are positive for *Campylobacter*, then cross-contamination is likely to occur because of poor hygiene practices and the ability of the organism to survive on surfaces.

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