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HACCP-based Fingertip Rinse Procedure

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SUMMARY

Fingers are frequently used to handle raw chicken on a cook's line. Raw, fresh chicken is often contaminated with vegetative pathogens such as *Salmonella* and *Campylobacter jejuni*. These pathogens can thus be transferred to fingers that touch raw chicken pieces and must be reduced to a safe level before the fingers touch other food products, particularly ready-to-eat food.

A hand washing sink, even in close proximity, is often not convenient for the frequent hand washing necessary to prevent cross-contamination. A possible solution to this food safety problem is described by the following simple procedure. The workstation is provided with a bucket containing 4 liters (4,000 ml) of bacteriostatic solution (water acidified to pH 3.5 with 5% acetic acid [vinegar]). A cloth, approximately 12 inches by 12 inches, is placed in the solution and used by the cook to wipe hands and fingers, thus providing the friction necessary for pathogen removal. Bacteria on fingers are reduced to a safe level, and the acetic acid (vinegar) solution dilutes the bacteria and inhibits bacterial growth. This study reports on an experimental test of this fingertip rinse procedure.

INTRODUCTION

Raw, fresh chicken is often contaminated with vegetative pathogens such as *Salmonella* and *Campylobacter jejuni (2, 3, 4, 7, 8). Salmonella* spp. is usually at a low level, perhaps 5 per chicken breast. However, *Campylobacter jejuni* has been found in chicken at much higher levels, as high as 10^5 to 10^6 CFU per chicken carcass *(8, 11)*. When a cook handles the chicken, there is the possibility of transferring 1,000 or more bacteria to the cook's hands and fingers. If the cook does not reduce transferred pathogens to a safe level before touching ready-to-eat food, the ready-to-eat food can become contaminated with a significant number of pathogens that can cause customers to become ill. An infective dose for *C. jejuni* is 400 to 500 vegetative cells *(1, 10)*.

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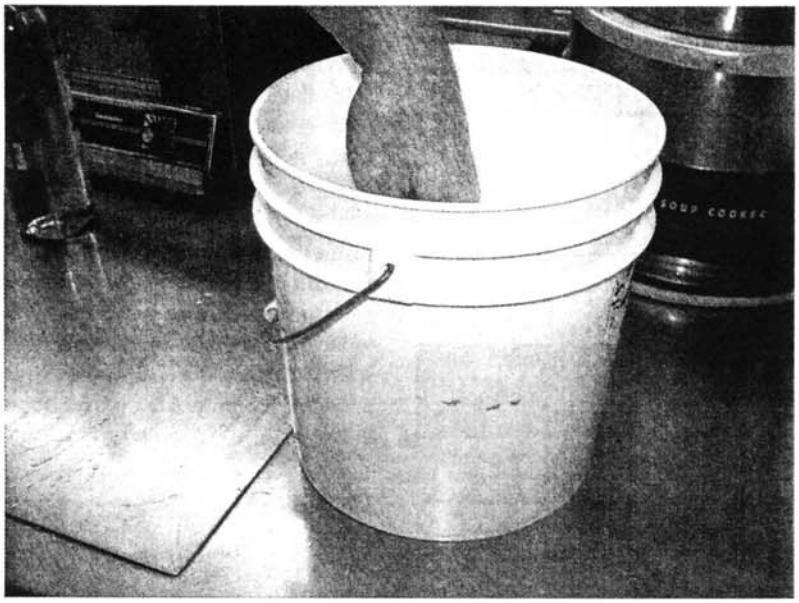
FIGURE 1. Bucket containing acetic acid rinse solution



Fresh, cooked chicken breast and chicken strips are common restaurant menu items. The food safety problem arises when the cook picks up pieces of raw chicken to put it on the grill or to batter it before placing it into the deep fat fryer. Fingers are the best "tool" for handling the chicken. To prevent cross-contamination, cooks who have handled poultry must wash their hands before handling any ready-to-eat food or touching any ready-to-eat food contact surfaces. While the FDA has not quantified the effectiveness of its recommended 20-second hand wash, the Hospitality Institute of Technology and Management research has shown that a single wash without fingernail brush friction will reduce marker organisms on fingertips about 100-fold *(12)*. However, a hand washing sink, even in close proximity, is often not conducive to the frequent hand washing required during peak hours of food preparation and service. Cooks could use disposable plastic gloves when handling raw chicken. However, even when gloves are worn, hands must still be washed according to FDA Food Code recommendations before gloves are put on and after removal *(5)*. Another possible solution for preventing cross-contamination of pathogenic bacteria from hands that have handled raw poultry to ready-to-eat food is to provide the workstation with a bucket of acetic acid solution (water acidified to pH 3.5 with 5% acetic acid [vinegar]).

Sanitizer solutions containing 50 ppm hypochlorite, 200 ppm quaternary ammonium compounds, or 12.5 ppm iodine do not have prolonged effectiveness, because they are rapidly inactivated by organic food soil. These sanitizer solutions are effective only on clean surfaces that contain little or no organic soil and cannot be relied upon to assure the reduction of bacteria on the surface of hands and fingertips that handle raw poultry. Although weak acetic acid solutions, at room temperature, require time to inactivate bacteria, these solutions are stable when contaminated with food waste and can be used both to inactivate bacteria and to inhibit bacterial growth *(9)*. It is thus reasonable to suggest that removal of bacteria from hands and fingertips and dilution with the use of an acetic acid solution can be used to reduce the risk of cross-contamination that may occur when food handlers prepare raw foods (e.g., raw poultry products) and then handle ready-to-eat foods (e.g., lettuce or fruit garnishes).

Fingertip rinse procedure

An acetic acid solution was prepared in a bucket with 4 liters of room-temperature water (16 to 32°C) and 15 ml of 5% acetic acid (distilled vinegar). The pH of the solution was 3.5. A clean 12 inch × 12 inch cloth was placed in the solution to provide friction when used to wipe hands and fingertips.

A culture of *Escherichia coli* ATCC 25922 was incubated at 37°C overnight in M broth (International BioProducts). This non-pathogenic species has been found to be very useful as a surrogate non-pathogenic vegetative microorganism for cleaning studies. The culture was diluted in phosphate buffer to about 100,000 *E. coli* per ml so that an inoculum of 10 microliters (containing about 1,000 bacteria) could be put on the first and second fingers of a vinyl gloved hand to simulate the contamination that occurs from touching chicken and the transferring of vegetative pathogens such as *C. jejuni*. The gloved fingers were then immersed in the bucket of acetic acid solution and wiped with the cloth for about 5 seconds.

The *E. coli* transferred to the solution was measured by use of pour plates with VRB (Violet Red Bile) agar plus 4-methylumbelliferyl-B-D-glucuronide (MUG). A pour plate was used because the diluent solution is slightly acidic, and this would prevent acid from affecting outgrowth. The number of *E. coli* was measured by preparing a multiple number of 10 plates and then combining the counts. For example, 1 ml of rinse solution was placed into each plate; thus, the total count of the 10 plates represented the number of bacteria per 10 ml of

TABLE 1. Number of *E. coli* ATCC 25922 per each 10-ml acetic acid rinse solution

Rinse	Test 1	Test 2
1st rinse	1 CFU / 10 ml	1 CFU / 10 ml
2nd rinse	4 CFU / 10 ml	3 CFU / 10 ml
3rd rinse	5 CFU / 10 ml	4 CFU / 10 ml

TABLE 2. Number of *E. coli* ATCC 25922 remaining on glove after 3rd rinse in acetic acid rinse solution

	Test 1	Test 2
Glove	2 CFU / 10 ml	6 CFU / 10 ml

TABLE 3. Number of *E. coli* ATCC 25922 remaining in the acetic acid rinse solution

Hours	CFU/10 ml
Initial	6
4 hours	1
8 hours	<1
24 hours	<1

solution. This procedure facilitated the enumeration of low levels of bacteria.

Following the first rinse in the acetic acid solution, the first and second fingers of the gloved hand were reinoculated with the *E. coli* ATCC 25922 culture and were rinsed again in the acetic acid solution. This procedure was done twice (a total of 3 times). Counts (CFU) were made of the *E. coli* in the acetic acid solution after each fingertip rinse.

To determine the number of *E. coli* ATCC 25922 remaining on the glove after the third rinse, the glove was put into a stomacher bag with 20 ml of phosphate buffer and pummeled for 30 seconds. The *E. coli* count on the glove was determined using the same 10-petri-dish system already described. To determine the viability of the *E. coli* ATCC 25922 in the acetic acid rinse water, a solution containing about 1,000 CFU/ml was prepared from the stock culture and added to 4,000 ml of the acetic acid rinse water. The *E. coli* ATCC 25922 were enumerated after 4 hours, 8 hours, and 24 hours of room temperature incubation.

RESULTS

The counts of *E. coli* ATCC 25922 in the acetic acid solution after the gloved fingers had been rinsed in the solution are shown in Table 1. After the first rinse, the count was 1 CFU per 10 ml of acetic acid solution; after the second rinse, the count was 4 CFU per 10 ml; and after the third rinse, it was 5 per 10 ml. These results indicate that *E. coli* ATCC 25922 was diluted to a low level in the acetic acid solution, even after contaminated gloved fingers had been rinsed in the solution 3 times.

The number of bacteria that remained on the glove was 2 in the first test and 6 in the repeat test.

The counts of *E. coli* ATCC 25922 inoculated into the acetic acid rinse solution that remained in this solution after 4, 8, and 24 hours are shown in Table 3.

DISCUSSION

This experiment shows that numbers of bacteria on fingers are significantly reduced by removal, dilution and destruction in an acetic acid solution. In the first fingertip rinse, if 2,200 *E. coli* CFU (total inoculum) on the gloved fingertips was completely transferred to the 4,000-ml acetic acid solution, the expected count of the solution would be 2,200 CFU per 4,000 ml, or about 1 CFU per 2 ml. However, the count was 1 CFU per 10 ml, indicating that some of the *E. coli* probably adhered to the cloth used to wipe fingertips and/or were inactivated by the solution. After the second rinse, the acetic acid solution should have had about 4,400 CFU per 4,000 ml, or 1 CFU per ml; however, 1 CFU per 2 ml was recovered. After the third rinse, 6,600 CFU per 4,000 ml, or about 2 CFU per 3 ml, might be expected to be present in the solution. Actually, only 1 CFU per 2 ml was recovered.

Enumeration of *E. coli* ATCC 25922 remaining on the gloves after the third fingertip rinse, when there were about 1 CFU per 2 ml solution, shows that most of the bacteria were removed by rinsing the gloved fingers in the acetic acid solution. If a food handler washes his/her hands using the FDA 20-second lather and rinse *(6)*, there may be a 100-fold reduction of bacteria on the hands. The method of dipping and rinsing gloved

fingertips in the acetic acid solution after 6,600 CFU *E. coli* ATCC 25922 has been added to the solution gave an even greater reduction of 3,300 CFU to 1 ml (or 6,600 CFU to 2 ml) than the 100 CFU to 1 ml rinse water that the Hospitality Institute of Technology and Management has estimated that the FDA 20-second hand washing method provides.

The acetic acid rinse solution used in this experiment provides a method for removal of *E. coli* ATCC 25922 from fingertip surfaces, as well as dilution and probable destruction of this bacteria.

CONCLUSION

In foodservice kitchens, hand washing sinks are not always near every workstation. As a result, cooks / food preparers may not wash and rinse their hands as often as necessary to prevent cross-contamination between raw foods and ready-to-eat foods. The FDA Food Code permits a bucket of sanitizer solution containing a cleaning cloth for use in sanitizing surfaces, but there is no mention of using a sanitizer solution for hands and fingers. It is known that all sanitizers currently used in foodservice facilities are sensitive to neutralization by organic material that is found on dirty cleaning cloths. This study shows that an acetic acid solution prepared with tap water and distilled vinegar (5% acetic acid), pH 3.5, effectively reduced *E. coli* ATCC 25922 on gloved fingertips.

To decontaminate the fingers (or gloved fingers) after touching a contaminated food such as raw poultry, fingers/hands could be rinsed in a bucket containing an acetic acid solution. The hands and fingertips should be wiped for 2 to 3 seconds on a clean, wet cloth in the bucket — enough to release food residue and bacteria. If desired, hands could be dried with a clean, dry paper towel. The food pathogens on the hands would thus be reduced to a safe level, and fingers could touch ready-to-eat food without danger of causing cross-contamination.

The acetic acid (vinegar) solution in the bucket should be changed when it becomes soiled, or within a 2 to 4 hour time period. This is an aesthetic/quality issue, not a food safety issue, because the pathogens will not grow to an unsafe level in the solution within the time it is used, and the solution will remain effective even if it contains organic soil.

Using an acetic acid solution to rinse hands and fingertips could be used as a critical control point (CCP) by cooks to remove pathogenic microorganisms from hand and finger surfaces after touching raw food on the cook's line before touching ready-to-eat food. The next step for this proposed hazard control is to validate it in operating conditions.

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