APPLIED MICROBIOLOGY, Apr. 1972, p. 796-798
Vol. 23, No. 4

Steam Versus Hot-Water Scalding in Reducing Bacterial Loads on the Skin of Commercially Processed Poultry

THOMAS E. PATRICK, T. L. GOODWIN, J. A. COLLINS, R. C. WYCHE, AND B. E. LOVE
Department of Animal Sciences, University of Arkansas, Fayetteville, Arkansas 72701

Received for publication 1 November 1971

A comparison of two types of scalders was conducted to determine their effectiveness in reducing bacterial contamination of poultry carcasses. A conventional hot-water scalder and a prototype model of a steam scalder were tested under commercial conditions. Total plate counts from steam-scalded birds were significantly lower than the counts of water-scalded birds immediately after scalding and again after picking. No differences in the two methods could be found after chilling. Coliform counts from steam-scalded birds were significantly lower than the counts from water-scalded birds immediately after scalding. No significant differences in coliform counts were detected when the two scald methods were compared after defeathering and chilling.

Scald water can be a source of bacterial contamination of broiler carcasses. Scald water, relatively free of microorganisms at the beginning of operation, increased to 1 million/ml at the conclusion of the day's operation (8). In other studies, the total bacterial counts of the scald water have been found to range from as low as 5,900 to 17,000 organisms/ml (9) to as high as 292 million/ml (4). The low numbers of bacteria obtained from scald waters in some studies could be attributed to a relatively high scald-water temperature (58 to 60 C), the low counts on some live birds, and the dilution effect of adding fresh scald water (2). Increasing the scald-water temperature resulted in an increased shelf-life of refrigerated poultry (10).

MATERIALS AND METHODS

The broilers used in this study were taken from the processing lines at a commercial broiler plant. One-half of the birds were scalded by using a conventional hot-water scalder at 55 C for 120 sec, and the other half were scalded with a steam-hot-water spray using a prototype of a steam scalder at a temperature of 53 to 55 C for 131 sec. Each of these scalding units was operated on separate defeathering and eviscerating lines.

Swab samples to determine bacterial contamination were taken from the thigh area of the birds at three different positions along the processing line for each type of scalder. These were: position 1, immediately after scalding; position 2, after picking; and position 3, after passing through the chilling system. Templates for taking samples were prepared from glass tubing with an inside diameter of 49 mm and ground to a sharp edge to give a clearly defined area of 1.88 cm^2 for each sample. Samples were taken from the thigh by swabbing with a sterile, commercially prepared, cotton-tipped swab which was rubbed over the area covered by the template, using parallel strokes and repeating at right angles (5). To reduce contamination, the templates were immersed in 70% ethanol for a minimum of 2 min between samples and air-dried before reuse. The swab samples were placed in test tubes containing 4 ml of 0.5% peptone broth. The tubes were stored immediately in an ice bath until plated (within 5 hr). Replicate samples from five birds each were taken at 7:00, 9:00, and 11:00 AM and at 2:00 and 4:00 PM to test for the possibility of buildup of bacteria during the day. The samples were plated in duplicate on standard plate count (SPC) agar (Difco) for total bacteria count and on violet red bile (VRB) agar (Fisher) for detection of coliforms. SPC agar plates were incubated for 48 hr at 32 C, and VRB agar plates were incubated at 37 C for 20 to 24 hr according to *Standard Methods for the Examination of Dairy Products* (1). Counts were expressed as number of bacteria per square centimeter of surface area swabbed. Samples were taken on 4 different days during 2 weeks of sampling. Data were analyzed by analysis of variance for each method (7). Differences between treatment means were separated by Duncan's multiple range tests (3).

RESULTS AND DISCUSSION

The log counts obtained during the 4 days of sampling were averaged at each of the five time intervals throughout each day. The av-

erage log counts of the water-scalded birds were higher than those of the steam-scalded birds at each sampling time at position 1 (Fig. 1). Bacterial counts on the carcasses scalded by each method increased at 4:00 PM over previous levels. The coliform counts remained relatively constant throughout the day at the three sampling positions, although some fluctuations in counts were noted. Both the scalding method and the time of sampling influenced the average counts for total bacteria present ($P < 0.01$).

At position 2, after picking, the bacterial loads on birds scalded in hot water were larger than the loads from steam-scalded birds (Fig. 2). This trend continued throughout the day at each sampling time. Method of scalding influenced the total bacterial load on the broilers after picking ($P < 0.01$). Sampling time did not have an effect on bacterial load.

The average log counts of total bacteria were similar for the two methods of scalding during the sampling intervals at position 3 (Fig. 3). Differences in bacterial counts between the two scald methods would not be expected to be apparent at this position. The bacterial loads on the birds had been washed off, diluted, and redistributed during the defeathering operation as well as being subjected to chlorination during the chilling operation.

The total bacterial counts at position 3 may not be an indication of the shelf-life of the birds. It has been suggested that seeding of

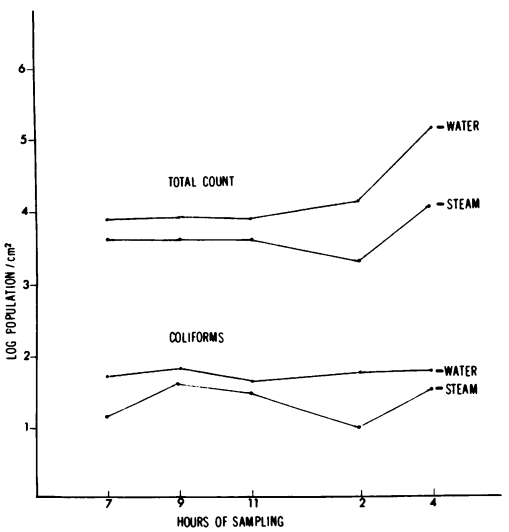

FIG. 1. *Log averages of total and coliform bacterial counts per square centimeter from swab surface samples of steam- and water-scalded broilers immediately after scalding. Samples were taken at 7:00, 9:00, and 11:00 AM and 2:00 and 4:00 PM.*

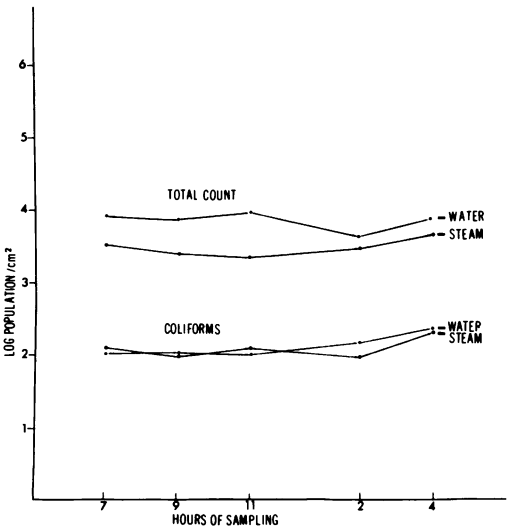

FIG. 2. *Log averages of total and coliform bacterial counts per square centimeter from swab surface samples immediately after picking.*

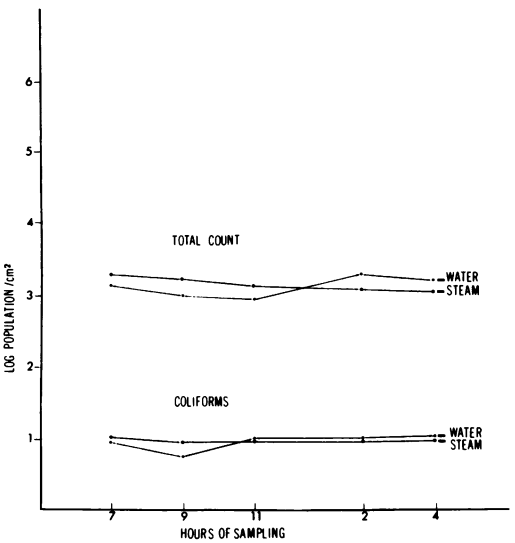

FIG. 3. *Log averages of total and coliform bacterial counts per square centimeter from swab surface samples immediately after chilling using a continuous chilling system.*

carcasses with psychrophiles occurs in slush ice chillers although total bacterial count decreases (6). Moisture pick-up by the carcasses may provide a more favorable environment for psychrophilic growth. Under the present processing operations of wet-chilling, steam-scalding would not be advantageous in decreasing bacterial loads. However, dry-chilling techniques are being introduced in some processing operations. In these operations, the

steam-scalded birds would enter the dry-chiller with lower bacterial contamination than water-scalded birds and would not be seeded with psychrophilic organisms as in water-chilling.

ACKNOWLEDGMENT

This work was supported by a grant from Food Equipment, Inc., Dallas, Tex.

LITERATURE CITED

1. American Public Health Association. 1967. Standard methods for the examination of dairy products, 12th ed. Amer. Publ. Health Ass., Inc., New York.
2. Brune, H. E., and F. E. Cunningham. 1971. Review of microbiological aspects of poultry processing. World's Poultry Sci. J. **27**:223-240.
3. Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics **11**:1-42.
4. Gunderson, M. F., H. W. McFadden, and T. S. Kyle. 1954. The bacteriology of commercial poultry processing. Burgess Publishing Co., Minneapolis.
5. Harrigan, W. F., and M. F. McCance. 1966. Laboratory methods in microbiology. Academic Press Inc., New York.
6. Knoop, G. N., C. E. Parmelee, and W. J. Stadelman. 1971. Microbiological characteristics of wet- and dry-chilled poultry. Poultry Sci. **50**:530-535.
7. Steel, R. G., and J. H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc., New York.
8. Tarver, F. R., and K. N. May. 1963. Effect of bleed time prior to scald and refrigerated storage upon bacterial counts in the axillary diverticula of the interclavicular air sac of chickens. Food Technol. **17**:198-201.
9. Walker, H. W., and J. C. Ayres. 1956. Incidence and kinds of microorganisms associated with commercially dressed poultry. Appl. Microbiol. **4**:345-350.
10. Zigler, F., and W. J. Stadelman. 1955. The effect of different scald water temperatures on the shelf-life of fresh, nonfrozen fryers. Poultry Sci. **34**:237-238.