Bacteriological Examination of Commercial Precooked Eastern-Type Turkey Rolls

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Studies were conducted to ascertain the bacteriological condition of commercially cooked Eastern-type (foil-wrapped-oven roasted) turkey rolls during processing and storage. After 2 weeks at 5 C, numbers of aerobes on the surface of rolls, in slices, and in whole rolls reached levels of from 1 to 10 million per cm² or per g. In stored whole rolls, coliform and enterococcus counts ranged, respectively, from about 10,000 to more than 1 million per g and from <100 to more than 1 million per g. Postcooking processing operations in two plants did not significantly affect the total count of turkey rolls. Eight of 28 rolls obtained after handling and packaging contained coagulase-positive staphylococci.

A variety of precooked poultry products are marketed for home and institutional consumption. Among the most popular of these items are precooked turkey rolls. Federal regulations (5) require that precooked turkey rolls be heated to an internal end-point temperature of 160 F (71.1 C). That such a procedure is effective in destroying salmonellae and coagulase-positive staphylococci in turkey meat has been demonstrated (3, 6).

The majority of ready-to-eat turkey rolls are cooked either by enclosing the raw roll in a fibrous moisture-proof casing and cooking in a hot-water bath, or by wrapping the roll in aluminum foil and oven roasting to the required end-point temperature. The casing used in the former method is not removed and usually serves as the final package, so that additional handling of the meat is not required. Bacteriological studies relating to this type of roll have been reported (2, 3; G. A. N. da Silva, Bacteriol. Proc., p. 12, 1967). With the latter type, often referred to as the Eastern-type (4), plant employees remove the foil after cooking and insert the roll into a plastic casing which is closed at one end. The natural juices from cooked rolls are combined with spices and gelatin (according to the formulation of each plant) and the mixture is heated to a minimum of 71.1 C. A portion of this heated mixture is then added to the casing, containing the roll, after which a vacuum is drawn and the casing closed at the other end.

Kinner et al. (4) showed that one of the major sources of bacteriological contamination of the Eastern-type roll is the natural juice-gelatin-spice mixture which is added before final packaging. They also showed that such mixtures should be heated to an end-point temperature of 82 C to reduce significantly numbers of coliforms and enterococci and to 93 C to reduce significantly the total bacterial count of these mixtures.

The objective of this study was to evaluate the bacteriological condition of commercial Eastern-type rolls immediately after processing and after various periods of refrigerated storage. Both intact packaged rolls (the form in which they would be stored by processors, distributors, or institutional users) and rolls from which slices were periodically removed during storage (to simulate a delicatessen or household practice) were evaluated.

MATERIALS AND METHODS

Stored roll studies. Packaged Eastern-type turkey rolls, each weighing between 5 and 7 lb (2.27 and 3.17 kg), were obtained from each of three commercial plants (A, B, and C). The rolls were from lots that had been processed 2 days previously and then held in the plant coolers. The rolls were placed in crushed ice in an insulated container and transported to the laboratory where they were placed in a laboratory refrigerator at 5 C. These rolls were examined bacteriologically as follows. (i) At intervals of 1, 4, 8, 11, 15, 18, 22, and 25 days, during storage at 5 C, two surface swabs were made on each of two rolls from each of the three plants. The same two rolls from each plant were sampled throughout the storage period, with different areas of the rolls swabbed on each sampling day. This was done by aseptically cutting, for each area, a flap in the casing of the roll of sufficient size to accommodate a sterile cardboard circular template which circumscribed an area of 12.3 cm².

After swabbing this area for 30 sec with a cotton swab moistened with 0.1% peptone solution, the flap was
closed and sealed with transparent tape. Serial decimal dilutions were then made and plated on plate count agar and the plates were incubated at 20°C for 72 hr. (ii) Six additional rolls, two from each of the three plants, were removed from the refrigerator at 5°C after 2, 16, and 30 days of storage. Each roll was cut approximately in half by using an electric knife with a sterile blade. One-half of each roll, with casing removed, was placed in a previously autoclaved large stainless-steel blender jar. Sterile distilled water, equal to the weight of the half roll, was then added to the jar and the roll was blended with the water at low speed for 4.75 min. During this period, the blender was turned off for 30 sec every 15 sec to avoid overheating the blender motor and the sample. Approximately 1 pint (473.2 ml) of the resulting homogenate was then poured into a sterile Mason jar and the remainder was discarded. Without rinsing the jar, the second half of the roll, with an equal weight of sterile distilled water, was blended in a similar manner and a pint of the homogenate was placed in another sterile Mason jar.

Serial decimal dilutions of each of these homogenates prepared in 0.1% peptone water were plated on Plate Count agar (incubated at 20°C for 72 hr) for total count, on Violet Red Bile agar for coliforms (18 to 24 hr at 35 to 37°C), on M-Enterococcus agar for enterococci (48 hr at 35 to 37°C), and on Sulfite Polymyxinsulfadiazine agar for Clostridium perfringens (24 and 48 hr at 37°C in anaerobic jars).

Salmonella determinations were carried out on 50 g of each of the homogenates. Sufficient extra strength selenite cystine broth was added to yield a mixture equivalent to 25 g of undiluted turkey roll meat to 225 ml of "normal" selenite broth. After incubating this mixture for 18 to 24 hr at 37°C, loopfuls were streaked on Brilliant Green Sulfa, Bismuth Sulfitc, and SS agars. After incubation at 37°C for 18 to 24 hr, typical Salmonella colonies were picked from these plates and transferred to Triple Sugar Iron and Lysine Iron agar slants. All cultures showing Salmonella reactions after 24 hr at 37°C were tested with Salmonella polyvalent "O" and Spencer-Edwards "H" antisera. (iii) Two sequential slices of approximately equal thickness (3 to 4 mm) were removed from each of two additional rolls from each plant after 1, 4, 8, 11, 15, 18, 22, and 25 days of storage at 5°C. After sampling, the remainder of each roll was placed in a polyethylene bag and returned to the refrigerator at 5°C until the next sampling day. Each slice was weighed and, with an equal weight of sterile distilled water, blended in a Waring blender for 2 min at low speed. Serial decimal dilutions of this homogenate were prepared and plated on Plate Count agar, and the plates were incubated at 20°C for 72 hr. Two slices from a roll on each sampling day were identified as "outer slice" and "inner slice."

Additional examinations. Employing the homogenized roll procedure described above, an additional 42 rolls obtained periodically from two plants over a 2-month period were examined (on the day after processing) for total counts, salmonellae, and C. perfringens. Coagulase-positive staphylococci in these rolls were also determined by the method of Baer (1). Fourteen of the rolls were obtained immediately after cooking, 14 were obtained immediately before the addition of the juice-spice-gelatin mixture, and 14 were "final packaged" rolls.

RESULTS AND DISCUSSION

Total counts of the surface of the ready-to-eat, foil-roasted rolls at various intervals during storage at 5°C are shown in Fig. 1. Counts of all rolls were relatively low after the first 4 days of laboratory refrigerator storage. After 11 days (plant and laboratory holding), five of the six rolls had at least one swab count in excess of 10⁴/cm², and, by the 14th day, counts of all rolls were in the range of 10⁶ to 10⁷/cm². After 18 days, counts remained relatively constant at 10⁶ to 10⁷/cm².

An analysis of variance of the swab bacterial counts revealed no significant difference among the rolls from the three plants nor between rolls within plants. With minor exceptions, the differences on any particular sampling day between swab counts on a roll were within the range of experimental error. Only rarely were differences greater than 1 log observed. This suggests that contamination is relatively uniform over the entire surface of this type of roll.

Total, coliform, and enterococcus counts of rolls stored for 2, 16, and 30 days are shown in Table 1. In all cases, counts between halves of the same rolls were in excellent agreement. No salmonellae or C. perfringens were detected in any of the rolls sampled.
Table 1. Logarithms of the number of bacteria per gram of precooked Eastern-type turkey rolls during storage at 5°C

| Organism      | Time at 5°C | Plant A | Plant B | Plant C |
|---------------|-------------|---------|---------|---------|
|               | days        | Roll 1  | Roll 2  | Roll 1  | Roll 2  | Roll 1  | Roll 2  |
| Total aerobes | 2           | <2.78   | <2.78   | <2.78   | <2.78   | <2.78   | <2.78   |
|               | 16          | 7.20    | 8.18    | 7.57    | 7.18    | 8.04    | 6.36    |
|               | 30          | 7.65    | 7.78    | 8.15    | 8.11    | 7.28    | 8.40    |
| Coliforms     | 2           | 2.30    | 2.15    | <1.30   | <1.30   | <1.30   | <1.30   |
|               | 16          | 6.57    | >6.78   | 5.90    | 4.11    | 5.15    | 4.76    |
|               | 20          | 7.18    | 7.23    | 4.77    | 6.11    | 7.00    | 7.54    |
| Enterococci   | 2           | 2.68    | 1.88    | <1.30   | <1.30   | <1.30   | <1.30   |
|               | 16          | 4.08    | 6.70    | 1.74    | 1.81    | 3.87    | 2.15    |
|               | 30          | 7.08    | 7.72    | 4.94    | 4.23    | 4.60    | 4.93    |

* Each value is based on two samples from each roll. (The roll is cut in half, each half is homogenized, and one sample is taken from each half.) Duplicate plates run on each sample.

The rate of increase in numbers of bacteria per gram of turkey slices during storage approximated that of the swab counts of the packaged roll (Fig. 2). Total counts of the outer slice were significantly greater than those from the inner slice, although the magnitude of these differences was not very great until late in storage. Since the slices included a portion of the external surface of the roll, possibly only bacteria on the external surface were determined. The higher counts of the "outer" than of the "inner" slice might be attributed to exposure of a larger surface area which would have encouraged growth of obligate aerobes transferred from the outside of the roll to the cut surface during slicing. Growth of such aerobes in the inner portion of the roll, however, where the oxygen tension is obviously much lower, would have been restricted. In a few instances, the presence of slime on the exposed surface of cut rolls stored for 3 weeks was noted. Significant off-odors were not detected, however.

Additional examinations. No significant differences were found in total counts among cooked rolls obtained at the three stages of processing. The majority of rolls obtained at the three stages had counts of less than 5000/g.

Salmonellae were found in 2 of 14 rolls taken directly from the oven but not in rolls obtained at the later two stages. Coagulase-positive staphylococci were found in 8 of the 28 rolls obtained at the later two stages and in 1 roll obtained directly from the oven. C. perfringens was not detected in any of the rolls examined.

Results of these examinations indicate that initial bacterial contamination of the Eastern-type turkey roll is relatively low. Numbers of bacteria may increase substantially, however, during refrigerated storage at 5°C in a matter of 2 to 3 weeks. Holding temperatures employed by processors usually range from about 34 to 40 °F (1.1 to 4.4°C). At delicatessen counters, however, temperatures may be nearer to 45 to 50 °F (7.2 to 10°C) so that extensive growth of bacteria as demonstrated here could occur in a relatively short period of time, with the possible development of slime.

**Fig. 2. Bacterial counts of "outer" and "inner" slices of "ready-to-eat" Eastern-type turkey rolls. Sequential pairs of slices were periodically removed from stored turkey rolls. Values are means of three slices, one from each roll, from each of three plants.**
The occasional finding of salmonellae and coagulase-positive staphylococci in this type of roll emphasizes the need for continuous in-plant application of effective temperature controls both with respect to cooking of the roll itself and of spice-juice mixtures added to the rolls. Stringent adherence to plant sanitation principles and practices during handling and packaging is also necessary to minimize contamination of the cooked product with food-borne pathogens.

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