Bacteriological Survey of Chopped Liver Produced at Establishments Under Federal Inspection

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ABSTRACT

At the time of manufacture, 74% of 27 sets of chopped liver (2 to 10 finished product units/set) collected from eight firms had aerobic plate counts (arithmetic averages) of fewer than 50,000/g, and 52% had 10,000 or fewer/g. Of the total of 209 finished product units, 57.4% were coliform-positive, but only 8.6% were Escherichia coli-positive and only one unit was Staphylococcus aureus-positive. All units were salmonellae-negative.

A survey was conducted to determine the bacterial levels of Kosher-style chopped chicken liver and Kosher chopped beef liver during preparation and as packaged for shipment from establishments under federal inspection in the United States.

In descending order of prominence, the product is a finely ground mixture of cooked livers, cooked onions, cooked eggs, cracker meal, vegetable oil or chicken fat, salt, and pepper. Two establishments (both producing chopped beef liver) did not add eggs to the product, two establishments added sugar (0.3% by weight), and one establishment did not add cracker meal. The Kosher chopped beef liver was prepared under rabbinical supervision. The product was either ladled manually or dispensed mechanically by a filling machine into 1- to 5-lb. plastic-lined cardboard containers, or into 4- to 8-oz. plastic containers.

Conditions of sanitation in the firms looked very good. All food contact surfaces were treated with a sanitizing agent after being cleaned, and hand-sanitizing solutions were used by employees. The cooked ingredients and finished product were chilled promptly. The firms seemed acutely aware that the product is very perishable.

MATERIALS AND METHODS

Sampling

From September 1974 to March 1976, samples were collected in eight establishments producing chopped liver. Four of the firms produced chopped chicken liver, three produced chopped beef liver, and one firm produced both products. The firms are located in the vicinity of New York City and represent most of the firms producing this product under federal inspection. Three of the firms froze the product and five refrigerated the product for shipment to outlets within 24 h.

A total of 211 production line samples and 209 containers of the finished product (units) were collected and analyzed. Each collection included samples of the ingredients, a set of two to 10 units (containers of the finished product) related to the production line samples, and when available, a set of two to 10 units produced the day before the plant visit. Groups of samples were collected from five of the firms on more than one date. The samples were frozen promptly and shipped under dry ice to the laboratory for analyses 3 to 4 weeks after collection.

Laboratory methods

Methods for aerobic plate counts (APC), coliforms, Escherichia coli, Staphylococcus aureus, and salmonellae have been described (3).

RESULTS AND DISCUSSION

Table 1 presents results of bacteriological examination of the finished chopped liver. Being a homogeneous product, the arithmetic average and geometric mean of the APC's of the units within a set were nearly the same.

A total of 95 samples of freshly cooked ingredients were collected in the eight firms. As expected, these samples were negative for coliforms and S. aureus, and had very low APCs. However, as seen in Table 1, the process of combining and packaging the cooked ingredients as a finished product usually resulted in some contamination despite the observed good sanitary conditions.

In Firms A and C, the cooked, chilled, ground ingredients increased in bacterial content after being combined as the finished product in a 200-lb. capacity horizontal tilt-type mixer. In both firms, the mixers had been washed and rinsed with a detergent and hot water, rinsed with a hypochlorite solution of more than 100 ppm Cl₂, then rinsed with potable water. However, because this type of mixer is not designed for routine disassembly, crevices at the junctions of the horizontal rotating shaft and the sides of the mixer, and at the junctions of the shaft and mixing blades, are not accessible for thorough cleaning. Firm C was one of only two firms where some E. coli-positive units were found and was the only firm that produced chopped liver with APC's greater than 100,000/g (Table 1).

A brief test was conducted at Firm C. Just before use,
the mixer was operated about 2 min while partially filled with potable water. Samples of the water before and after contact with the mixer were collected in sterile jars containing a few crystals of sodium thiosulfate to neutralize residual Cl₂. The samples were immersed in crushed ice and delivered to the laboratory for examination within five hours. The potable water was sterile in 0.1-ml portions, but the water from the mixer contained 1,000 coliforms/ml and had an APC of 200,000/ml. Because of these findings, the firm was advised to operate the cleaned mixer filled with a sanitizing agent for at least 5 min just before final rinsing and use. Unfortunately, samples to measure the effect of this treatment could not be collected because the firm discontinued manufacture of the product.

In Firm B, the cooked chilled ingredients increased in bacterial content after being ground and mixed in a chopper ("silent cutter"). Before use, the cleaned chopper bowl was filled with an I₂ solution of more than 100 ppm for 0.5 h, then operated while draining the I₂ solution and rinsed with potable water. It seems that the cutting blades of a chopper must be removed and disassembled for thorough cleaning and sanitization before using this equipment for a cooked product.

Firm D produced both chopped chicken liver and chopped beef liver. The chicken liver ingredients were cooked together and, while hot, ground and mixed in a chopper along with cooked, chilled onions and dry ice pellets (for rapid chilling). The beef liver ingredients were cooked together and, while hot, passed through a grinder directly into a horizontal tilt-type mixer for blending with cooked, chilled onions and dry ice pellets. The product increased in bacterial content after contact with the chopper or the mixer. Just before use, the cleaned equipment was rinsed with an I₂ solution of more than 100 ppm.

In Firm E, the freshly cooked ingredients, while hot, were mixed and ground and pumped directly through a column-type heat exchanger for rapid chilling. When contamination occurred, it was noted in the samples collected at the discharge of the heat exchanger. Firm E was the second of two firms where some E. coli-positive finished chopped liver units were found (Table 1). The heat exchanger was cleaned-in-place with recirculated detergent solution, rinsed, and partially disassembled for treatment with a solution of 100 ppm of a quaternary ammonium compound. However, the heat exchanger, with numerous interior scraper-blades, is difficult to clean and sanitize unless disassembled completely.

In Firm F, the freshly cooked ingredients, while hot, were ground with cooked, chilled onions; then mixed in a free-standing dough mixer. Before use, the cleaned, detached, one piece vertical mixing arm and smooth-walled portable mixing bowl were treated with a hypochlorite solution of more than 100 ppm Cl₂. The warm product was spread on chilled, shallow pans; covered with clean white paper; and placed in a freezer for rapid chilling before being packaged about 3 h later. Occasionally, slight contamination of the product resulted from passage through a mechanical cup-filling

**TABLE 1. Results of analyses of finished chopped liver units**

<table>
<thead>
<tr>
<th>Firm</th>
<th>Liver</th>
<th>No. of units/SET</th>
<th>No. of units with</th>
<th>Aerobic plate counts/g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coliforms</td>
<td>E. coli</td>
</tr>
<tr>
<td>A</td>
<td>Chicken</td>
<td>10</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>Chicken</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>Chicken</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>Chicken</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>G</td>
<td>Chicken</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>Beef</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>Beef</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>H</td>
<td>Beef</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

aEach set represents a different day of production

bEvery unit was salmonellae-negative in 25-g portions
In Firms G and H, the cooked chilled ingredients were ground and then mixed in a free-standing dough mixer. Before use, the cleaned detached mixing arm and portable mixing bowl were treated with solutions of either 100 ppm I₂ or 100 ppm of a quaternary ammonium compound. Very little contamination of the product was noted in these firms.

Table 2 shows the effect of processing equipment on the coliform content of chopped liver. Most of the coliform contamination resulted from the use of equipment hard to clean and sanitize. The samples of chopped liver prepared in the dough mixer (equipment easier to clean and sanitize) had a lower incidence and fewer numbers of coliforms.

**TABLE 2. Effect of processing equipment on the coliform content of finished chopped liver units**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>No. of units</th>
<th>No. of units with coliforms/g at</th>
<th>% of Units coll. pos.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopper</td>
<td>45</td>
<td>16, 13, 9</td>
<td>84</td>
</tr>
<tr>
<td>Tilt-mixer</td>
<td>73</td>
<td>41, 12, 1</td>
<td>74</td>
</tr>
<tr>
<td>Column-exchanger</td>
<td>39</td>
<td>12, 5, 0</td>
<td>43</td>
</tr>
<tr>
<td>Dough-mixer</td>
<td>52</td>
<td>11, 0, 0</td>
<td>21</td>
</tr>
</tbody>
</table>

On three occasions, sets of chopped liver units delivered under crushed ice for examination within 24 h were reexamined after 3 weeks of frozen storage at -23°C. The results are presented in Table 3. In all, there appeared to be some reduction in viable coliforms during frozen storage but no significant differences in APCs.

On four occasions, sets of chopped liver units (two of chicken and one each of beef produced with and without eggs) were delivered under crushed ice on the day of manufacture and stored in the laboratory refrigerator at 2°C. At intervals, portions were examined bacteriologically and organoleptically. Figure 1 shows the rate of bacterial growth (APCs) in these products during refrigerated storage. The chopped chicken liver was the most perishable and developed an off-odor after 17 days of refrigerated storage. As expected, the chopped beef liver formulated without eggs was the least perishable, but developed a slightly sour odor after 21 days. There was little, if any, growth of coliforms during refrigerated storage, and all samples were negative for S. aureus and salmonellae at every examination. The dominant microorganisms isolated from the organoleptically unacceptable chopped liver were identified as pseu-
domonads and enterococci.

This survey shows that at the time of manufacture and by the laboratory methods employed, 20 (74.1%) of the 27 sets of finished chopped liver units (2 to 10 units/set) had APCs (arithmetic average) of fewer than 50,000/g; and 14 sets (51.9%) had APCs of 10,000 or fewer/g. Of the 27 sets, 22 (81.5%) contained coliform-positive units. Of the 209 units, 120 (57.4%) were coliform-positive but only 18 (8.6%) were E. coli-positive and only one (0.5%) was S. aureus positive. All units were salmonellae-negative in 25-g portions.

We found only two articles in the literature referring to this type of product. Pace (2), during a surveillance of delicatessen foods, collected 12 samples of “liver spread” at a central production kitchen and found that the aerobic plate counts ranged from 100 to 100,000/g and found that four of the 12 samples contained 10 to 100 coliforms/g.

In 1968, consumption of chopped chicken liver packed in a glass jar and produced in a non-federally inspected plant resulted in a case of botulism (1). However, U.S.D.A. investigation at that time revealed evidence that the jar of chopped liver, though labeled “keep refrigerated,” had been stored at room temperature by both the retailer and the purchaser. As a result of this case, the U.S.D.A. does not permit perishable pasteurized products to be packaged in hermatically sealed rigid containers (glass jars or cans) unless the product is pH 4.5 or lower.

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REFERENCES