Microbiological Survey of Frozen Ground Meat and a Proposed Standard

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ABSTRACT

A microbiological survey of frozen ground meat was conducted during a period of five years, 1975-1980. Five hundred and nineteen samples of frozen ground beef and 172 samples of frozen ground fowl were examined. Bacteriological tests performed included aerobic plate count (APC), Staphylococcus aureus, Streptococcus faecalis and Salmonella. A proposed standard limiting distribution of the various bacteria found in frozen ground meat was proposed. The data indicated that frozen ground fowl was heavily contaminated (33%) with Salmonella, therefore according to our findings, this product should not be processed.

The microbiological quality of ground meat has been of interest to a number of investigators in different geographical areas, and resulted in the publication of several papers (4,9,3,16). Published reports (10,14) implicated this type of meat as the source of some forms of microbially associated infection and intoxication. These products included hamburger, meat loaf, meat balls, cooked ground meat, etc. The pathogens could either have survived cooking (8) or were introduced into the product after it had been cooked (2). Salmonella (5), Staphylococcus aureus (1) and Clostridium perfringens (12) have been the main etiological agents associated with foodborne disease caused by ground beef. Salmonella being the most significant pathogen transmitted by meat (6), most of the research on prevention of foodborne infection from meat is devoted to study of the effect of this on the human population. The microbiological quality of this product will depend upon the meat used for grinding, sanitary conditions during preparation and time and temperature of storage (17). Establishment of bacteriological criteria should reflect both the benefit to the consumer and cost to the producer. Comparison between raw and frozen ground meat (13) indicated that the later product had a lower bacterial count, and fewer Salmonella sp. were isolated. Bacteriological standards for ground beef have been published and enforced in some places (3,11,13,15). Most of them were connected with raw ground beef, only one with frozen ground beef (13) and none of them with frozen ground poultry.

By law in this country (Israel) frozen ground meat can be sold only while still frozen and during 30 d following grinding and packaging. During 5 years, 1975-1980, a survey was made of the bacteriological quality of frozen ground meat. The data collected could be used as a basis for proposal of a realistic standard, which could be upheld and thereby decrease the possibility of foodborne disease.

MATERIALS AND METHODS

Samples

Samples were taken over a period of 5 years from processing storerooms and multiple outlets. The samples were delivered to the laboratory in a frozen state. Twenty grams of frozen ground meat was placed in a Waring blender with 180 ml of sterile 0.1% peptone water and homogenized for 1-2 min. Further dilutions were made in 0.1% peptone water.

Aerobic plate count (APC)

The aerobic plate count was done by seeding prepared dilution in petri dishes and mixing it with Plate Count Agar (Difco) which had been kept at 45-50°C before pouring. Plates were incubated at 35°C for 48 h.

Staphylococcus aureus

Staphylococcus aureus counts were made by the direct plate count method using Baird-Parker’s Egg Yolk Tellurite Agar plates which were incubated for 48 h at 37°C. Colonies, samples of each type, were picked and streaked on Blood Agar Base. The isolates were tested for coagulase production by the tube method.

Streptococcus faecalis

Streptococcus faecalis were enumerated on KF Streptococcus agar which was incubated for 48 h at 37°C.

Salmonella

Two subsamples containing 20 g of frozen ground meat were used for Salmonella determination. The first sample was homogenized in Dulcitol Selenite Broth in a Waring blender for 3 min and transferred to a sterile flask. The second subsample was treated identically using Muller Kauffman as the selective enrichment broth. Dulcitol Selenite Broth was incubated at 42°C for 24 h, whereas Muller Kauffman Broth was incubated at 37°C for 24 h. Following incubation, the bacteria were subcultured on Brilliant Green Agar and incubated at 35°C for 24 h. Suspected colonies were tested biochemically and identified by the serological method; positive results indicate the presence of Salmonella in 20 g of ground meat.

RESULTS

Distribution of Aerobic Plate Count, Staphylococcus aureus

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A total of 519 samples of frozen ground beef and 172 samples of frozen ground fowl meat were examined and the results of the Aerobic Plate Counts (APCs), Staphylococcus aureus, Streptococcus faecalis and Salmonella counts are in Table 1. The data indicate that APCs show the same distribution in both beef and fowl frozen ground meat. Most samples (88%) did not exceed the level of 50 million bacteria/g. Very few samples of ground beef were contaminated with Staphylococcus aureus, while a higher contamination level was observed in ground fowl meat. More than 40% of the samples from both beef and fowl contain more than 100 Streptococcus faecalis/g. Higher contamination with Salmonella was observed in frozen ground fowl than in frozen ground beef. In frozen ground beef, an increase in the incidence of Salmonella contamination paralleled the increase in bacterial counts and probably reflects poorer sanitation during handling, thus increasing the potential hazard. Fowl is usually contaminated with Salmonella, and the degree of finding of this organism in frozen ground fowl is considerably higher and no distinct pattern could be attributed to the APCs.

Proposed microbiological standard for frozen ground meat

The data presented in this paper indicate that some samples had APCs and were contaminated with S. aureus, S. faecalis and Salmonella. During the last decade various proposed bacteriological standards have been published (3, 7, 13); all of them for raw ground beef, with various subsamples. Our proposal is based on one sample and the regulations are made according to two limits; a lower limit, \( m \) = maximum number of bacteria with no concern, and an upper limit, \( M \) = number of bacteria which would violate the standard.

<table>
<thead>
<tr>
<th>Organism tested</th>
<th>Number of bacteria per gram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( m )</td>
</tr>
<tr>
<td>APC</td>
<td>( 5 \times 10^6 )</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>100</td>
</tr>
<tr>
<td>Streptococcus faecalis</td>
<td>100</td>
</tr>
<tr>
<td>Salmonella</td>
<td>0(^a)</td>
</tr>
</tbody>
</table>

\(^a\)Absent in 20 g of the subsamples.

When three of the results fall between \( m \) and \( M \) values, the sample would not be acceptable, by this standard. Analysis of data of this survey based on this proposed standard, indicated (Table 3) that the rejection rate was 25.6% for frozen ground beef as opposed to 48.8% for frozen ground fowl. It should be mentioned that one of the main reasons for the rejection of frozen ground fowl was the presence of Salmonella (33%) as opposed to 7.6% in ground beef.
TABLE 3. Rejection of frozen ground meat samples from our survey by the proposed standard.

<table>
<thead>
<tr>
<th>Type of meat</th>
<th>Rejection by the upper limit</th>
<th>Additive of three between M - M</th>
<th>Total Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Three</td>
<td>Two</td>
<td>One</td>
</tr>
<tr>
<td>Beef</td>
<td>5</td>
<td>0.9</td>
<td>18</td>
</tr>
<tr>
<td>Fowl</td>
<td>12</td>
<td>7.0</td>
<td>12</td>
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DISCUSSION

The grinding process of the meat will distribute bacteria normally present on the surface throughout the entire product, and create an ideal condition for their multiplication. Thus the microbiological quality of the frozen ground meat depends upon the quality of the meat used, sanitary conditions practiced during preparation and the temperature at the time of storage. The relatively higher contamination of fowl (11%) than of beef (2%) (Table 1) with *S. aureus* suggests the existence of the bacteria in all the flocks of birds.

Poultry is the most important meat source used in this country (Israel). Both chicken and turkey are frequently contaminated with *Salmonella*. The results of this study indicate that 33% of frozen ground fowl was contaminated with *Salmonella*.

We think that establishment of microbiological control will be an important factor in decreasing the health hazard of this product. Elliott (7) pointed out that of the various microbial criteria only a microbiological standard as a part of a law, with prescribed limits, methods for testing and an agency for control, has any meaning in improving the quality of ground meat.

The conclusion, according to our data (Table 3) is that under present conditions 25.6% of the samples of frozen ground beef would be rejected and that would be less than obtained by the Canadian standard (13). As a result of the high rejection rate of ground fowl meat (49%) and the high isolation rate of *Salmonella* (33%), we feel that this product should not be processed and sold to the public.

A standard could be made flexible depending upon the levels of m or M, and this would more or less protect the consumer, but of course be more expensive. Implementation of any standard would depend upon the authorities, and we believe that once it is done the microbiological quality of frozen ground meat would improve and decrease the hazard to public health.

REFERENCES