A Research Note

Microbial Counts on Surfaces of Lamb Carcasses and Shelf-Life of Refrigerated Ground Lamb

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(Received for publication November 16, 1981)

ABSTRACT

Aerobic plate counts (APC) and counts on psychrophils, coliforms, Staphylococcus aureus and molds plus yeasts were made from the surface of fresh lamb carcasses and in ground lamb during refrigerated storage in Baghdad, Iraq. The average surface counts of carcasses sampled weekly over a 16-wk period were $1.1 \times 10^6$ cm$^{-2}$ and $2.6 \times 10^6$ cm$^{-2}$ for APC and psychrophils, respectively. The average ground lamb counts sampled weekly over a 5-wk period were $3.1 \times 10^5$ g and $1.2 \times 10^5$ g for APC and psychrophils, respectively. The average coliform, S. aureus and yeast plus mold counts were all between $10^3$ and $10^4$ CFU per cm$^2$ or g for carcasses and ground lamb, respectively, on the day of slaughtering. Upon storage of the ground lamb at 2, 4, 5 and 6°C, both APC and psychrophil counts increased to $10^9$ CFU/g within 1 wk with more rapid microbial growth as the storage temperature increased from 2 to 6°C. Organoleptic spoilage was first detected when APC reached $10^9$ CFU/g, or about 6 d at 5 to 6°C. The fat content of the ground lamb did not appreciably affect the APC and psychrophil counts. Of 50 isolates of S. aureus, 48 were coagulase-positive.

Meat is very susceptible to microbial spoilage. The types and numbers of microorganisms present in meat reflect the degree of sanitation from slaughtering to display, as well as the conditions that might have allowed microbial growth during that period. In refrigerated meat, the dominant types of microorganisms are psychrotrophic, especially Pseudomonas spp. (3,8).

The microbial quality of meat has been studied extensively (1,2,4,5,7,9,11,12), and microbial standards of meat quality have been proposed (10,13), although no such standards have been used by regulatory agencies.

The microbial quality of lamb has not been studied sufficiently despite the fact that lamb is consumed in considerable quantities in many parts of the world, especially the Middle and Near East countries. This investigation was aimed at providing information on the numbers and types of microorganisms present in lamb as marketed in Baghdad, Iraq.

MATERIALS AND METHODS

Meat sample

Two types of samples were used: lamb carcasses and ground lamb. Carcasses delivered to retail butcher shops from a government operated slaughterhouse were examined once a week, on the day of slaughter through 16 weeks, by swabbing. Swabs were taken from five scattered spots on each of three different carcasses and subjected to analysis within 1 h. Ground lamb was purchased from the same butcher shop where the carcasses were sampled. Meat was ground within 24 h after slaughtering and immediately before purchase. Ground lamb was sampled weekly for 5 wk. The microbiological analyses for the initial counts commenced within 1 h from the time of purchase.

Microbiological analyses

The procedures described in the Bacteriological Analytical Manual for Foods (6) were used. Specifically, in analysing ground lamb, 11 g of sample were placed in a sterilized polyethylene bag with 99 ml of sterilized 0.1% peptone water and macerated in a Stomacher 400 for 3 min. After the appropriate dilutions, the macerate was plated on nutrient agar and aerobic plate counts (APC) were obtained after 2 d at 35°C, while psychrophil counts were determined after 7 d at 7°C. The coliforms were estimated on violet red bile agar after 24 h at 35°C. Only large colonies with the violet color typical of coliforms were presumed to be coliforms. The S. aureus population was estimated on mannitol salt agar after 2 d at 35°C; typical gold-colored colonies were counted. Coagulate rabbit plasma was used to detect coagulase-positive S. aureus. Molds and yeasts were enumerated on acidified (fattoric acid) potato dextrose agar after 5 d at 20°C. Bacteriological media used throughout the study were obtained from Oxoid Limited.

Storage studies

All storage studies were done with freshly ground lamb. In a first test, three 150-g portions were held in sterile beakers at 5°C. The pH, APC and psychrophil counts were obtained initially and again when organoleptic spoilage (off-odor) was first detected. In a second test, quadruplicate 150-g portions were placed in: (a) sterile unsealed polyethylene bags, (b) non-sterile unsealed polyethylene bags, and (c) sterile open beakers and held at 5°C. APC and psychrophil counts were made every other day up to sensory spoilage. In the third test,
RESULTS AND DISCUSSION

The types and numbers of microorganisms found on the surface of lamb carcasses and in ground lamb appear in Table 1. In both instances, the APC were greater than the psychrotroph counts. While the APC of the carcass surface were about 10-fold higher than the APC of ground lamb, the opposite was true for the psychrotroph counts. A comparison with beef would not indicate large differences in counts. A comparison with beef would not indicate large differences for coliforms, S. aureus.

TABLE 1. Microbial counts on the surfaces of carcasses and in the ground meat of lamb on the day of slaughter.

<table>
<thead>
<tr>
<th>Sampling types</th>
<th>Aerobic plate count</th>
<th>Psychrotrophs</th>
<th>Coliforms</th>
<th>S. aureus</th>
<th>Yeast and mold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcasses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range/cm²</td>
<td>3.3 × 10^5-4.5 × 10^6</td>
<td>2.6 × 10^3-6.0 × 10^4</td>
<td>6.9 × 10^2-3.3 × 10^3</td>
<td>1.3 × 10^3-1.3 × 10^4</td>
<td>3.6 × 10^2-7.0 × 10^3</td>
</tr>
<tr>
<td>Mean/cm²</td>
<td>1.1 × 10^6</td>
<td>2.6 × 10^4</td>
<td>1.6 × 10^3</td>
<td>6.6 × 10^3</td>
<td>3.1 × 10^3</td>
</tr>
<tr>
<td>Ground lamb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range/g</td>
<td>6.5 × 10^4-8.8 × 10^5</td>
<td>1.1 × 10^4-3.1 × 10^5</td>
<td>1.5 × 10^3-9.3 × 10^3</td>
<td>3.2 × 10^2-1.3 × 10^4</td>
<td>6.0 × 10^2-1.8 × 10^4</td>
</tr>
<tr>
<td>Mean/g</td>
<td>3.1 × 10^5</td>
<td>1.2 × 10^5</td>
<td>3.4 × 10^3</td>
<td>3.4 × 10^3</td>
<td>5.8 × 10^3</td>
</tr>
</tbody>
</table>

48 out of 50 isolates of S. aureus were coagulase-positive.

50 S. aureus isolated, 48 were coagulase-positive.

The results of the test in which ground lamb was stored at 5°C until it spoiled 6 days later are as follows. The pH increased from 5.8 to 7.1. The APC rose from 1.5 × 10^5 CFU/g to 3.5 × 10^6 CFU/g. In a previous study, Al-Delaimey and Stiles (1) found that the APC and psychrotroph counts of ground beef stored at 5°C rose to 10^8 CFU/g within 4 d with ensuing sensory spoilage.

The type of container did not cause large differences in APC or psychrotroph count of the ground lamb samples stored at 5°C. In all three containers (sterilized and unsterilized polyethylene bags and open sterilized beakers), all samples had the same initial counts for coliforms, S. aureus and molds plus yeasts ranged from 10^2 to 10^4 CFU/g or cm², indicating that rather poor sanitation conditions prevailed during meat handling. Of 50 S. aureus isolated, 48 were coagulase-positive.

The results of the test in which ground lamb was stored at 5°C until it spoiled 6 days later are as follows. The pH increased from 5.8 to 7.1. The APC rose from 1.5 × 10^5 CFU/g to 3.5 × 10^6 CFU/g. In a previous study, Al-Delaimey and Stiles (1) found that the APC and psychrotroph counts of ground beef stored at 5°C rose to 10^8 CFU/g within 4 d with ensuing sensory spoilage.

The type of container did not cause large differences in APC or psychrotroph count of the ground lamb samples stored at 5°C. In all three containers (sterilized and unsterilized polyethylene bags and open sterilized beakers), all samples had the same initial APC of 2.1 × 10^5 CFU/g and psychrotroph count of 3.1 × 10^5 CFU/g. On the 6th day of storage, sensory spoilage was detectable in all samples; at this time the APC and psychrotroph counts were about 3 to 4 × 10^9 CFU/g. On the 8th day, spoilage was pronounced and all counts were in the range of 0.5 to 2.5 × 10^10 CFU/g.

The results of the effect of the three different storage temperatures on the APC and psychrotroph count of ground lamb are summarized in Fig. 1. As would be expected, both counts increased more rapidly with rising storage temperature. Similar results on ground beef have been reported by Duitschaever et al. (4).

The fat concentration of ground lamb did not greatly affect microbial growth during 8 d at 5°C (Fig. 2).

We conclude from the limited findings of this work that the APC and psychrotroph counts of lamb meat, as

![Graph showing microbial counts over days of storage at different temperatures.](http://meridian.allenpress.com/jfp/article-pdf/45/11/1013/1654741/0362-028x-45_11_1013.pdf)
Figure 2. Aerobic plate count and psychrotroph counts of ground lamb with three levels of fat (lean, 18.1%; standard, 32.4%; and fatty, 77.9%) during storage at 5°C for 8 d.

acknowledgment of organisms from the intestinal tract of the animals and from the environment.

acknowledgments

We thank Professor P. Markakis of the Department of Food Science and Human Nutrition, Michigan State University, for proofreading the manuscript.

references