ABSTRACT

Forty samples of frozen imported lean beef pieces from six countries were obtained from two centralized meat processing operations. The samples were analyzed for total aerobic counts (35, 20, 7 C), yeasts and molds, fecal streptococci, Staphylococcus aureus, Clostridium perfringens, total coliforms, fecal coliforms, Escherichia coli, and Salmonella. Characterization of the microbial flora from 20 of the samples was also done. Microbial counts were consistently low in all analyses; no Clostridium perfringens or Salmonella was recovered from any samples. The microbial flora was predominantly Pseudomonas, Flavobacterium, Moraxella, Acinetobacter, Corynebacterium, Micrococcus, Staphylococcus and Lactobacillus; the remaining isolates included Alcaligenes, Erwinia, Citrobacter, Klebsiella, Streptococcus, Bacillus and Arthrobacter.

Considerable work has been done on the microbiology of retail ground beef (4,6,9,10,12) and the interest in some form of bacterial standards for this product continues (3,8). Field et al. (5) reported on sources of variation at the retail level in the bacteriological condition of ground beef and concluded that there would be merit for standards for centrally packaged ground beef in terms of (a) elapsed time between packaging and retail sale and (b) temperature considerations. In centralized processing of ground beef, frozen imported lean beef pieces are often blended with domestic trimmings. Recent statistics (11) indicate that in excess of one billion pounds of manufacturing beef were imported into the United States in 1976. Much of this product was used in the manufacture of ground beef, although the exact amount is not known.

Our study was undertaken to determine the overall microbiological quality of frozen imported lean beef pieces and to classify the specific microflora recovered from our samples.

MATERIALS AND METHODS

Forty samples of imported lean beef pieces were randomly obtained from two centralized meat processing operations in Florida over a 3-month period. Samples were derived from lots of beef imported from Nicaragua, New Zealand, Costa Rica, El Salvador, Honduras and/or Guatemala. Frozen samples were obtained immediately after hydro-flaking (coarse cutting) and kept frozen until just before analysis in the laboratory.

Methods employed for microbiological analyses were essentially those in the Bacteriological Analytical Manual for Foods (BAM) with the exception that a surface plating technique was used for total aerobic counts (7). Samples were partially thawed for 4-6 h at 5 C just before analysis. One 25-g subsample was homogenized in 225 g of sterile phosphate buffer dilution water for 2 min at low speed (8,000 rpm) in a Waring blender. Serial dilutions of this homogenate were used for the following microbiological analyses: total aerobic plate counts on pre-poured plates of Plate Count agar incubated at 35 C for 48 h, 20 C for 5 days or 7 C for 10 days; yeast and mold counts on Plate Count agar with added antibiotics at 20 C for 5 days; fecal streptococci counts on KP-streptococcus agar at 35 C for 48 h; and Clostridium perfringens on Tryptose Sulfite Cycloserine (TSC) agar with egg yolk emulsion incubated anaerobically in a GasPakR system at 35 C for 24 h. An MPN procedure using Lauryl Sulfate Tryptose (LST) broth followed by confirmation in Brillant Green Bile broth (2%) was used to estimate total coliforms. Confirmation in EC broth at 45.5 C determined fecal coliform populations. Escherichia coli was quantified from positive EC tubes according to BAM procedures. Staphylococcus aureus was enumerated with the MPN method using 10% NaCl Tryptic Soy Broth (TSB) followed by streaking onto plates of Baird Parker agar and confirmation of typical colonies with a tube coagulase test.

For Salmonella analyses, a separate 25-g subsample was blended with 225 ml of sterile lactose broth and the resulting homogenate transferred to a sterile flask. After incubation at 35 C for 24 h, 1-ml aliquots of the resulting culture were added to either 10 ml of Selenite Cystine broth or 10 ml of Tetraphionate broth followed by incubation at 35 C for 24 h. Selective plating (using Brillant Green agar, Salmonella-Shigella agar and Bismuth Sulfite agar) and subsequent biochemical and preliminary serological identification were also done. Dehydrated culture media were Difco products except for TSC and 10% NaCl TSB which were formulated from individual components.

Bacterial isolates were taken from total aerobic plates (35, 20, or 7 C). Individual colonies representing different morphological properties were selected from spread plates. Such colonies (equal to the square root of the number of colonies on countable plates) were transferred to Tryptic Soy agar slants for taxonomic characterization. A total of 458 isolates were obtained in this manner from 20 of the 40 samples. Standard microbiological techniques were used in the

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RESULTS AND DISCUSSION

Results of the microbiological analyses are in Tables 1 and 2. There were no apparent differences between the microbial counts of the samples as related to country of origin, although insufficient numbers of samples were obtained from some of the countries for a valid statistical comparison. There was little variation in microbial counts among the 40 samples.

Total aerobic counts of all but four samples at 35 and 20°C were in the range of 10^3 to 10^4 organisms/g. Surface plating was used in an effort to minimize trauma to plated cells. Highest total aerobic counts were obtained at 20°C for all samples while lowest total aerobic counts occurred at 7°C (Table 1). There was variation in the yeast and mold counts among the samples but mean counts were low. Likewise, variability occurred in the fecal streptococci counts from sample to sample with overall means being very low.

Coliform counts were low for all of the samples as shown in Table 1. The total coliform counts varied among samples with all but two of 40 samples having counts in the range of 0-43 organisms/g. The mean fecal coliform counts and E. coli counts were low for the samples, with 34 of 40 samples yielding no E. coli. No S. aureus was recovered from 22 of 40 samples and all but one sample had counts less than or equal to 9.1 per g. Neither Salmonella nor C. perfringens was recovered from any of the samples.

A variety of both gram-positive and gram-negative organisms was isolated from 20 of the imported lean beef samples (Table 2). There was little variation in the predominant flora from sample to sample or from country to country. As might be expected, the microflora varied according to the incubation temperature used for the plates from which they were isolated. For example, Staphylococcus spp. were recovered from 75% of the samples at 35°C incubation while none were recovered from the samples at 7°C. At all temperatures, the most frequently isolated gram-negative organisms were Pseudomonas spp., Flavobacterium spp., Moraxella spp. and Erwinia herbicola.
Acinetobacter spp., while Corynebacterium spp., Micrococcus spp., Staphylococcus spp. and Lactobacillus spp. were the most frequently isolated gram-positive organisms. With the exception of Staphylococcus, the predominant organisms were psychrotrophs commonly found on refrigerated fresh beef. Species of staphylococci were found on 85% of the samples and included only one coagulase-positive isolate. Few members of the Enterobacteriaceae family were isolated with Erwinia herbicola being most often recovered. Four of six streptococci isolates were Streptococcus faecalis (found on 25% of the samples).

Processing conditions such as initial microbial quality of fresh trimmings, method of freezing and duration of cold storage before export from the six countries were, unfortunately, not known. Factors such as these would obviously affect the microbial flora of this product in terms of both types and numbers present. With this in mind, our results indicate that the microbiological quality of the imported lean beef pieces used for ground beef at two centralized operations was good. The low total aerobic counts indicate that this product would have a negligible effect on the initial microbial quality of ground beef prepared from imported lean and domestic trimmings because suggested plate count standards for ground beef approximate $10^6$ per g.

REFERENCES
11. USDA. 1977. From Animal and Plant Health Inspection Service’s (APHIS) testimony before the Senate Subcommittee on Agriculture and Forestry, Washington, D.C.