Research Note

Microbiological Condition of Ground Meat Retailed in Monterrey, Mexico

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ABSTRACT

Eighty-eight samples of ground meat were randomly collected from retail stores in the metropolitan area of Monterrey, Mexico, and were analyzed for microbial contamination. Methods were those recommended by the Mexican regulation and/or the U.S. Food and Drug Administration. Over 75% of the samples contained $10^5$ total mesophilic microorganisms per g, and over 40% had $>10^6$ total coliforms per g. Fecal coliforms were present in most samples. Staphylococcus aureus was detected in 2.3% of the samples, Salmonella spp. in 11.4%, Listeria spp. in 62%, and L. monocytogenes in 16%. Escherichia coli was detected in 76% of samples, but none was serotype O157:H7. Shigella spp. was not found in any sample. Fusarium spp. and Mucor spp. were detected in 3.4% of the samples, and low levels of yeast in 93%. The microbiological quality of the ground meat analyzed was unsatisfactory, and the product could be an important cause of food poisoning.

Animal carcasses and cuts of meat become contaminated with microorganisms from soil, animal feces, or food handlers during slaughtering and processing. Mesophilic bacteria, molds, and yeast frequently contaminate ground meat (2). Previous studies in other countries on the microbiology of different kinds of meats have demonstrated the presence in these products of potentially pathogenic bacteria that include Salmonella, Escherichia coli, Listeria monocytogenes, Clostridium perfringens, Bacillus cereus, etc. (2, 14). Factors that contribute to the contamination of ground meat by pathogens and spoilage bacteria include improper holding or storage temperatures, poor personal hygiene of food handlers, cross-contamination and poor slaughtering practices (2).

The main sources of ground meat for consumers are supermarkets and butcher’s shops. The former are generally large chains of stores with a quality control department, while the latter are usually individually managed and operated by their owners. There is little information about the microbiological condition of ground meat retail in these Mexican markets, so the risks to consumer health from that product is uncertain. Therefore, the microbiological condition of ground meat offered for retail sale in metropolitan Monterrey was investigated.

MATERIALS AND METHODS

Samples. A total of 88 randomly collected samples of ground meat were analyzed. Samples (250-g) were purchased from 44 supermarkets and 44 butcher’s shops in the metropolitan area of Monterrey, N.L. Mexico (cities of San Nicolas, Guadalupé, San Pedro, and Monterrey). The samples were stored at 4°C until they were examined, but for no more than 4 h after being purchased.

Preparation of samples. For plate count determinations, a 10-g portion of each sample was weighed into a sterile tared blender jar containing 90 ml of sterile (0.85% wt/vol) saline. The diluted samples were homogenized in a blender for 1 min and then allowed to stand for approximately 5 min at 4°C to allow the coarse material to settle (17).

Sample analysis: microbial counts. Aerobic plate count. One-milliliter samples from dilutions of $10^{-1}$ to $10^{-5}$ were spread on duplicate plates of plate count agar (1.5% agar, 5% pancreatic digest of casein, 2.5% yeast extract, and 1% glucose) that were incubated at 35°C for 48 h.

Coliform and fecal coliform count. Coliforms were estimated by a three-tube most probable number method in lauryl sulfate tryptose broth (Difco, Detroit, Mich.) by standard methods (4). Presumptive coliforms from tubes of lauryl sulfate tryptose broth in which gas was produced were confirmed by growth in brilliant green lactose bile (2%) broth. Fecal coliforms were estimated by transferring growth from positive lauryl sulfate tryptose broth tubes to E. coli broth that was incubated at 44.5°C for 48 h.

E. coli O157:H7. From each fecal coliform-positive culture, 100 µl was inoculated onto eosin methylene blue agar (Difco) and McConkey agar (Difco). Typical colonies on both agars were isolated and subjected to biochemical tests (glucose, lactose, sucrose, and sorbitol fermentation, lysine and ornithine decarboxylation, and urease production). The methylumbelliferyl-β-glucuronidereaction (production of β-glucuronidase) also was performed. The colonies that were negative to all the tests were analyzed for the O157 and the H:7 antigen by latex agglutination using the commercial kit RIM (Remel, Lenexa, Kans.) (12). Polymerase chain reaction was carried out to look for the presence of genes specific of E. coli O157:H7: eaeA (397 bp), uidA (252 bp), styI (348 bp), etc.
Stx2 (584 bp), and for the plasmid enterohemorrhagic E. coli (166 bp) (11).

Salmonella and Shigella. Lactose broth (Difco) was used as preenrichment medium. Portions of 30 g were homogenized in tubes with 90 ml of medium. Following incubation for 24 h at 37°C, 1 ml of each preenrichment broth was inoculated into a tube with 9 ml of the selective enrichment tetrathionate broth (Difco) and incubated for 24 h at 37°C. An aliquot of this broth was then streaked onto plates of xylose-lysine-deoxycholate (Difco). Plates were incubated for 24 h at 37°C and then examined for typical colonies. Presumptive Salmonella and Shigella were confirmed by biochemical tests (3).

Yeast and mold count. Dilutions prepared for aerobic plate counts also were used for yeast and mold enumeration. One milliliter of each dilution was used to prepare pour plates of potato dextrose agar (Difco) acidified to pH 3.5. Plates were incubated at 23°C for 5 days. Identification of colonies was by macroscopic and microscopic examination (13). All determinations were duplicated. An analysis of variance test was used to determine differences of contamination among supermarkets and butcher's shops.

RESULTS

Total aerobes were recovered from samples at numbers between $10^4$ to $10^6$ CFU/g (Table 1). More than 75% of the samples contained these organisms at numbers $>10^5$, and more than 40% contained $>10^6$ total coliforms per g. There was a large variation in the numbers of fecal coliforms recovered from the samples. No significant difference ($P > 0.05$) in contamination of mesophilic aerobic, total coliforms, or fecal coliform microorganisms was observed among type of source store.

E. coli was found in 76% of the samples tested. Thirty-two butcher's shop samples and 35 supermarket samples carried E. coli. Of the 67 strains of E. coli isolated, only two were methyllumbelliferyl-β-glucuronide and sorbitol fermentation negative. Several analyses were carried out on the two isolates, including immunological hemagglutination for serotype H7 and O157, and polymerase chain reaction to detect the genes Stx1, Stx2, uidA, eae, and pla. All the tests were negative. It seemed that the strains belonged to some inert serotype but not to enterohemorrhagic E. coli O157:H7.

Salmonella was detected in 11.4% of the samples tested. Six samples from butcher's shops and four from supermarkets carried the bacterium. Our findings indicated that 55 (62.5%) of the samples tested carried Listeria spp., and from these, 18 samples carried L. monocytogenes (16% total). Only two samples were positive for Staphylococcus aureus, one from a supermarket (500 CFU/g) and the other from a butcher's shop (100 CFU/g). Both were from the same municipality. Shigella spp. was not detected in any sample tested.

Ninety-three percent of the samples carried yeasts. Levels were observed from $<100$ to $10^6$ CFU/g, although more than 75% of the samples carried lower than $10^4$ CFU/g. Filamentous fungi were found in only three samples (3.4%), two from butcher's shops and one from a supermarket. Isolates were identified as Fusarium and Mucor.

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<th>Source</th>
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<th>Supermarkets</th>
<th>Total coliform</th>
<th>Butcher's shop</th>
<th>Supermarkets</th>
<th>Fecal coliform</th>
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DISCUSSION

Although the levels of contamination of total aerobes seem to be high in the samples, the Mexican regulations allow a limit of $5 \times 10^6$ CFU/g, and only two samples exceeded that limit. It has been reported that high levels of mesophilic bacteria in a food such as meat can be dangerous for consumers, as some of these microorganisms could be pathogenic (6). Reports have indicated the presence of E. coli O157:H7 especially in beef and vegetable products; however, high variation in frequency of the bacterium has been reported (1, 18). Our data suggest that retail ground beef was neither frequently nor heavily contaminated with E. coli O157:H7 at the point of sale in Monterrey markets. Nonetheless, because ground beef is a vehicle for the transmission of E. coli O157:H7 infection, such food should be considered hazardous if improperly handled or prepared, even if end-product testing fails to indicate the presence of this pathogen (10). Furthermore, high E. coli levels could indicate the presence of other pathogenic forms of this bacterium. Although the Mexican legislation does not permit the presence of Salmonella in 25 g of food, the microorganism was detected in 11.4% of the samples tested. Salmonella surveys have been carried out on different kind of foods, and the levels vary according to the product tested (5, 19). Listeria spp. and L. monocytogenes are commonly found in the environment and they have been isolated from a variety of foods including processed meat (7, 9, 15). The levels found here were similar to those reported by other authors (16, 20).

There is no regulation in the Mexican legislation about the presence of yeasts or filamentous fungi in foods. The main problem with fungi is that they can reach high numbers and spoil the product, producing economic loss.

No statistical difference ($P > 0.05$) in contamination by pathogenic microorganisms was observed among source store. Thus, contamination could come from inappropriate manipulations during grinding or poor slaughtering practices (8).

Although several microorganisms were present in relatively high levels in the samples, proper cooking, manipulation, and processing of the ground beef could diminish the hazard. However, considering that the microbiological quality of ground beef in the metropolitan area of Monterrey, Mexico is deficient, and the widespread use of this product, there is a need to stress the importance of correct handling of the food, both at a domestic and commercial level. There is an evident need to establish standards of compliance for ground beef to give the user a reliable safe product.

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REFERENCES