# HYGIENIC CONDITIONS OF A MEXICAN LOCAL SLAUGHTERHOUSE

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## Background

Healthy cattle are a reservoir for the major foodborne pathogens like *Escherichia coli* O157, *Salmonella spp*., *Listeria spp*. and *Campylobacter spp*. and these microorganisms may be transferred onto the meat during slaughter and dressing of the carcasses (Vanderlinde and Shay, 1998). Apart from pathogenic bacteria, isolated spoilage microorganisms include lactic acid bacteria, *Pseudomonas spp.*, *Acinetobacter spp.* and *Moraxella spp.* (Kraft, 1992). Microorganisms are in the intestinal tract of the animals, on its hide, hair and hooves (Gill and Newton, 1978). Generally, the internal surfaces of the carcasses are sterile, but during the slaughtering process, defects on dressing and skinning led to the contact of carcasses with dust, dirt and feces, and facilitate the contamination of the meat with the microorganisms deposited on the surface of the animals.

Equipment and utensils used in the slaughtering plants play an important role in the cross-contamination of carcasses. For example, in the case of swine cattle although bacteria on the skin are largely destroyed by scalding, the skin is recontaminated with spoilage and pathogenic bacteria during passage of the carcass through the dehairing equipment (Gill and Bryant, 1993). Workers could be also another microbial contamination source.

In this way, safety programs have been adopted in the slaughtering plants in order to improve meat safety. Good manufacturing practices (GMP) emphasize sanitary effectiveness and hygienic practices during the processing of foods. Hazard analysis critical control point (HACCP) is mainly directed to identify and control foodborne pathogens. In USA every slaughter plant that operates under federal inspections is committed to establish and carry out a HACCP program as well as to apply sanitation standard operating procedures (SSOP) (USDA, 1996). In the European Union the UE Commission Decision (2001/471/EC) requires validated HACCP systems in the slaughter plants and conduct regular checks on general hygiene. However none of these safety programs are compulsory in slaughterhouses in Mexico, especially in non TIF (Federal Inspection Type) slaughterhouses. Therefore, microbial counts in these establishments are expected to be quite high but no studies are related to the subject.

## Objectives

The aim of this work was to conduct a microbiological evaluation of the slaughtering process at a small slaughterhouse located in Hidalgo State, Mexico.

## Materials and methods

The slaughter house involved in the study is located in Pachuca, Hidalgo State, Mexico, and it has one line for pigs and one line for cattle. Over a nine-month period the local slaughtering establishment was sampled eight times, four times in each line. At each sampling time, nine carcasses were randomly selected immediately after slaughter and dressing and sampled. Four zones of 100 $cm^2$ were strongly swabbed with cheese cloth previously moistened with buffered peptone and placed in a same sterile Stomacher bag constituting a single composite sample. In case of swine, zones swabbed were ham, back, belly and jowl and in beef carcasses the zones swabbed were leg, belly, breast and jowl. Also knives used for the bleeding, scrapping, skinning and evisceration as well as saws used to split the sternum and carcasses of beef and hands of different personnel working were sampled by swabbing technique. The water from the scalding process and used to wash the carcasses was also analysed.

The swab samples were cultured and enumerated for the presence of total viable count (TVC), coliforms, *E. coli*, *Salmonella* and *Staphylococcus aureus*. Plate count agar (PCA) was used to enumerate total viable count, Petrifilm Coliforms/*E. coli* (3M) was used to enumerate coliforms and *E. coli* and Baird Parker agar to enumerate *Staphylococcus aureus.*

For detection of *Salmonella spp.*, 100 ml of buffered peptone water was used for preenrichment at 37ºC for 18 h. Selective enrichment was done in Rappaport-Vassiliadis (RV) broth and tetrathionate broth. Isolation and identification were performed by plating on xylose lysine desoxycholate (XLD) agar and modified brilliant green agar (BGAM). One suspect colony on each plate was inoculated on triple sugar iron agar (TSI) and lysine iron agar (LIA) for identification. Also multivalent serum agglutination was performed to confirm the presence of *Salmonella*.

## Results and discussion

A total of 158 samples were analysed (74 samples in pork line and 84 samples in beef line). Results of TVC (total viable count), coliforms and *E. coli* are shown in tables 1 and 2. Total viable counts were recovered from all samples and coliforms and *E. coli* from most samples. Generally speaking, carcasses, utensils and workers were more contaminated in pig line than in beef line. However, counts in carcasses were higher than those found by Gill et al. (2000) in beef and pig carcasses. Anyway TVC values found in pig carcasses were all higher than 4 Log cfu/cm$^2$ which for example according to Commission Decision 2001/471/EC would be considered unacceptable. In beef carcasses TVC counts ranged from 3.26 to 7.00 Log cfu/cm$^2$ and but coliforms were lower than 1.5 Log cfu/cm$^2$ or were not present except in five samples and *E. coli* counts were not detected in half samples. High counts in utensils and worker hands indicated absence of good manufacturing practices which facilitate the contamination of carcasses. Respecting the water used to clean the carcasses the presence of coliforms and *E. coli* could be explained due to the fact that the water prior to be used is placed in an open container and could be contaminated during the slaughtering process.

Respecting *Salmonella*, 31% of the samples were positive for *Salmonella spp* in the porcine line and 11% were positive in the bovine line. It is well documented that *Salmonella* enters into the slaughterhouse through the animals, especially pigs and although scalding step could reduce the presence of this pathogen, subsequent operations as dehairing, manual scraping and polishing and evisceration contribute significantly to cross-contamination and could explain the prevalence of *Salmonella* in the carcasses, knives and hands of the workers. The percentage value found in pork line is slightly higher than the value found by Korsak et al. (1998) in four pork slaughterhouses; however, these authors did not found *Salmonella spp* in the beef slaughterhouses sampled. *Staphylococcus aureus* was not detected in any sample. This microorganism in foods usually indicates contamination from skin, mouth or nose of food handlers.

## Conclusions

High microbial counts present in carcasses, utensils and personnel working indicated poor hygienic conditions in the slaughtering establishment and implementation and maintenance of Good Manufacturing Practices (GMP) and Hazard Analysis Critical Control Points (HACCP) should be the strategy in order to assure the microbial safety of meat.

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Table 1. Microbial results of the samples obtained from carcasses, utensils, workers and water at pork slaughtering process.

| Microbial count | Sampling site | Number of samples | Mean | Standard deviation | No |
|---|---|---|---|---|---|
| Total viable count | Carcasses (Log cfu/cm$^{2)}$ | 32 | 5.01 | 0.84 | - |
| | Utensils (Log cfu/utensil) | 15 | 6.77 | 0.84 | - |
| | Workers (Log cfu/hand) | 19 | 7.13 | 0.98 | - |
| | Scalding water (Log cfu/ml) | 4 | 3.70 | 1.01 | - |
| | Cleaning water (Log cfu/ml) | 4 | 2.89 | 1.18 | - |
| Coliforms | Carcasses (Log cfu/cm$^{2)}$ | 32 | 2.54 | 1.47 | - |
| | Utensils (Log cfu/utensil) | 15 | 3.72 | 2.42 | 2 |
| | Workers (Log cfu/hand) | 19 | 4.88 | 1.53 | - |
| | Scalding water (Log cfu/ml) | 4 | 0.70 | 0.58 | 3 |
| | Cleaning water (Log cfu/ml) | 4 | 0.38 | 1.29 | 2 |
| *E. coli* | Carcasses (Log cfu/cm$^{2)}$ | 32 | 1.26 | 0.74 | - |
| | Utensils (Log cfu/utensil) | 15 | 2.19 | 1.52 | 3 |
| | Workers (Log cfu/hand) | 19 | 3.54 | 1.09 | - |
| | Scalding water (Log cfu/ml) | 4 | 0.24 | 0.46 | 3 |
| | Cleaning water (Log cfu/ml) | 4 | 0.15 | 0.52 | 3 |

No: number of samples from which bacteria were not recovered

Table 2. Microbial results of the samples obtained from carcasses, utensils, saws, workers and water at beef slaughtering process.

| Microbial count | Sampling site | Number of samples | Mean | Standard deviation | No |
|---|---|---|---|---|---|
| Total viable count | Carcasses (Log cfu/cm$^{2)}$ | 36 | 4.39 | 1.04 | - |
| | Utensils (Log cfu/utensil) | 16 | 6.09 | 1.38 | - |
| | Saws (Log cfu/saw) | 8 | 6.67 | 1.55 | - |
| | Workers (Log cfu/hand) | 20 | 6.74 | 1.05 | - |
| | Cleaning water (Log cfu/ml) | 4 | 4.61 | 0.32 | - |
| Coliforms | Carcasses (Log cfu/cm$^{2)}$ | 36 | 1.11 | 1.81 | 7 |
| | Utensils (Log cfu/utensil) | 16 | 2.15 | 2.94 | 7 |
| | Saws (Log cfu/saw) | 8 | 4.38 | 2.64 | - |
| | Workers (Log cfu/hand) | 20 | 3.95 | 2.22 | 2 |
| | Cleaning water (Log cfu/ml) | 4 | 3.23 | 1.28 | - |
| *E. coli* | Carcasses (Log cfu/cm$^{2)}$ | 36 | 0.44 | 0.95 | 18 |
| | Utensils (Log cfu/utensil) | 16 | 0.67 | 1.85 | 11 |
| | Saws (Log cfu/saw) | 8 | 0.58 | 1.53 | 5 |
| | Workers (Log cfu/hand) | 20 | 2.47 | 1.93 | 5 |
| | Cleaning water (Log cfu/ml) | 4 | 2.84 | 1.25 | - |

No: number of samples from which bacteria were not recovered