MICROBIOLOGICAL CONDITIONS AT LOCAL SLAUGHTERHOUSES IN HIDALGO, MEXICO

Godínez G., Reyes J.A.1, Zúñiga A.1, Sánchez I.1, Rovira J.2, Jaime I.2, Castro, J.1, Román A.D.1, Santos E.M.1*

[1.] Universidad Autónoma del Estado de Hidalgo; Centro de Investigaciones Químicas; Ciudad Universitaria; 42076 Pachuca, Hidalgo, México
[2.] Universidad de Burgos; Departamento de Biotecnología y Ciencia de los Alimentos; Pza Misael Bañuelos s/n; 09001 Burgos, España

Key Words: slaughterhouse, hygiene, carcass, microbial contamination

Introduction

Microbial contamination of meat occurs since animal is slaughtered when the microorganisms deposited on the surface of livestock, slaughter facility equipment, food handlers or present in the intestinal tract or in the environment contact with the meat as a consequence of deficient hygienic conditions during the slaughtering process. Pathogens commonly isolated from raw beef and pork include *Salmonella* spp., *E. coli*, *Campylobacter jejuni* and *Listeria monocytogenes* (Eisel et al., 1997) and *Pseudomonas, Enterobacteriaceae, Brochothrix thermosphacta* and lactic acid bacteria are considered frequent spoilage microorganisms present in meat (Gustavsson and Borch, 1993).

In this way, safety programs have been adopted in the slaughtering plants in order 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 (Eisel et al., 1997). In USA every slaughter plant that operates under federal inspections is committed to establish and carry out a HACCP program as well as 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.

In México almost 50% of the slaughtering is done at the local slaughterhouses while TIF (Federal Inspection Type) slaughterhouses where more hygienic conditions are observed, account only for the 25% of the slaughter (SAGARPA, 2002). However no SSOP or HACCP programs are compulsory in any slaughterhouse in this country. So microbial counts in these establishments are expected to be quite high but no studies are related to the subject, especially Hidalgo State where there is not located any TIF slaughterhouse.

Objectives

To assess the microbial conditions of the slaughtering process at four small slaughterhouses located in Hidalgo State, Mexico.

Methodology

Four local slaughterhouses located in Hidalgo State (Mexico) were involved in the study where swine and cattle is slaughtered everyday. Data found for one of the studied slaughterhouses were previously reported (Hernández et al., 2004). Every slaughtering establishment was sampled 3-4 times both pork and beef lines. Every sampling time, nine carcasses were randomly selected immediately after slaughter and dressing and sampled. Four sites of 100 cm^2 were strongly swabbed with cheese cloth premoistened with buffered peptone and placed in a same sterile Stomacher bag constituting a single composite sample. In case of swine swabbed areas were ham, back, belly and jowl and in beef carcasses the swabbed zones were ham, 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* and *Salmonella*. Plate count agar (PCA) was used to enumerate total viable count, Petrifilm Coliforms/*E. coli* (3M) was used to enumerate coliforms and *E. coli.* 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 & Discussion

A total of 467 samples were analysed (227 samples corresponding to pork lines and 240 samples corresponding to beef lines). Results of TVC (total viable count), coliformes, *E. coli* and incidence of *Salmonella* are shown in tables 1 and 2 for pork and beef samples, respectively. Total viable counts, coliforms and *E. coli* were recovered from the majority of samples indicating faecal contamination except in water samples where coliforms and *E. coli* were only detected in samples from one of the slaughterhouses. In that plant the origin of faecal contamination of water could be explained because the cleaning water is deposited in an opened container prior to be used and could be contaminated during the slaughtering process.

In general average TVC from carcasses, utensils and workers were quite similar in both lines around 4.5 Log cfu/cm^2 and values ranged from 2.08 to 7.90 Log cfu/cm^2 in pork samples and from not detected to 7.88 Log cfu/cm^2 in beef samples. Similar results for both lines were also observed for coliforms and *E. coli* in samples from workers and utensils but average counts were below 2 Log cfu/cm^2. Presence of coliforms and *E. coli* in utensils and workers hands indicates absence of good manufacturing practices which facilitate the contamination of carcasses although this effect was more noticeable in pork carcasses than in beef. These microbiological results were higher to those observed by Gill et al. (2000) in a small abattoir where different animal species were slaughtered.

The overall prevalence of *Salmonella* (18%) in the study was a rather high value similar to those observed by Korsak et al. (1998) in four pork slaughterhouses

however these authors did not found *Salmonella* spp in the beef slaughterhouses sampled. In our study prevalences of *Salmonella* were also irregular since this microorganism was hardly recovered in one of the plants which had a low rate of pork slaughter whereas its presence was more important in the slaughterhouses with a higher rate of pork slaughtering. It is well documented that *Salmonella* enters into the slaughterhouse through the animals, especially swine and although scalding step could reduce the presence of this pathogen, posterior 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 in both lines in the rest of the slaughterhouses studied.

Conclusions

Elevated microbial counts present in carcasses, utensils and personnel working as well as high presence of coliforms and E. coli indicate poor hygienic conditions in all slaughtering establishments and confirm that hygiene standards and good management practices are extremely important to contain the rate of carcass contamination. In addition the implementation of some kind of post-slaughter treatment like hot water pasteurizing or spraying with one or several organic acids would be recommended to reduce the levels of microorganisms (Jay, 1996; Gill et al., 1999).

References

Commission Decision 2001/471/EC (2001) Official Journal L165, 21/06/2001, pp. 0048–0053.

Eisel, W.G., Linton, R.H., Muriana, P.M. (1997) A survey of microbial levels for incoming raw beef, environmental sources, and ground beef in a red meat processing plant. Food Microbiology 14, 273–282.

Gill, C.O., Bryant, J., Bedard, D. (1999) The effects of hot water pasteurizing treatments on the appearances and microbiological conditions of beef carcass sides. Food Microbiology 16, 281–289.

Gill, C.O., Jones, T., Bryant, J., Brereton, D.A. (2000) The microbiological conditions of the carcasses of six species after dressing at a small abattoir. Food Microbiology 17, 233–239.

Hernández, S., Zúñiga, A., Rovira, J., Jaime, I., Sanchez, I., Santos , E.M. (2004) Hygienic conditions of a Mexican local slaughterhouse. In proceedings of 50th International Congress of Meat Science and Technology, 633–636. Helsinki. Finland.

Jay, J.M., (1996) Microorganisms in fresh ground meats: the relative safety of products with low versus high numbers. Meat Science 43, S59–S66.

Korsak , N., Daube, G., Ghafir, Y., Chahed, A., Jolly, S., Vindevogel, H. (1998) An efficient sampling technique used to detect four foodborne pathogens on pork and beef carcasses in nine Belgian abattoirs, Journal of Food Protecttion, 61, 535–541.

SAGARPA (2002) Situación actual de la producción de carne de bovino en México. Claridades Agropecuarias 109, 3–32.

USDA, Pathogen reduction: Hazard Analysis and Critical Control Point (HACCP) Systems; Final Rule. (1996) Federal Regulation 61, 38805–38855.

Tables and Figures

Table 1. Microbial results in Log cfu/cm^2 or Log cfu/mL of the samples obtained from carcasses, utensils, workers and water at pork slaughtering process in the slaughterhouses sampled.

Number of samples	Sampling site	Microbial count	Mean	Standard deviation	Minimum	Maximum	Incidence (%)
95	Carcasses	TVC	4.65	0.75	3.28	6.90	100
		Coliforms	1.60	0.99	-0.60	4.64	100
		E. coli	1.18	0.78	-0.60	3.92	100
		Salmonella	-	-	-	-	17
58	Workers	TVC	4.46	1.05	ND	7.90	98
		Coliforms	1.63	1.14	ND	4.49	97
		E. coli	1.13	0.96	ND	3.76	95
		Salmonella	-	-	-	-	36
48	Utensils	TVC	4.68	1.06	2.08	7.08	100
		Coliforms	1.67	1.26	ND	4.94	90
		E. coli	1.16	0.99	ND	3.78	81
		Salmonella	-	-	-	-	13
13	Scalding water	TVC	3.20	1.14	ND	5.30	100
		Coliforms	0.09	0.34	ND	1.23	8
		E. coli	0.04	0.13	ND	0.48	8
		Salmonella	-	-	-	-	0
13	Cleaning water	TVC	2.29	1.32	ND	4.46	85
		Coliforms	0.19	0.62	ND	2.23	15
		E. coli	0.12	0.42	ND	1.52	8
		Salmonella	-	-	-	-	0

ND = Not detected

Table 2. Microbial results in Log cfu/cm^2 or Log cfu/mL of the samples obtained from carcasses, utensils, saws, workers and water at beef slaughtering process.

Number of samples	Sampling site	Microbial count	Mean	Standard deviation	Minimum	Maximum	Incidence (%)
100	Carcasses	TVC	4.50	1.14	2.31	7.41	100
		Coliforms	0.79	1.22	ND	6.01	86
		E. coli	0.12	0.85	ND	3.44	76
		Salmonella	-	-	-	-	18
58	Workers	TVC	4.69	0.88	2.52	6.90	100
		Coliforms	1.63	1.21	ND	5.63	91
		E. coli	1.10	1.05	ND	3.37	84
		Salmonella	-	-	-	-	19
43	Utensils	TVC	4.65	1.27	ND	7.88	98
		Coliforms	1.46	1.30	ND	7.26	74
		E. coli	0.87	1.09	ND	2.63	56
		Salmonella	-	-	-	-	19
26	Saws	TVC	4.38	1.30	2.28	7.45	100
		Coliforms	1.30	1.44	ND	6.40	92
		E. coli	0.17	0.83	ND	3.30	58
		Salmonella	-	-	-	-	15
13	Cleaning water	TVC	3.07	1.49	ND	5.32	92
		Coliforms	1.52	1.84	ND	4.76	31
		E. coli	1.21	1.62	ND	3.64	31
		Salmonella	-	-	-	-	0

ND = Not detected.