THE EFFECT OF MEAT SAFETY SYSTEMS AT HIGH THROUGHPUT ABATTOIRS ON THE MICROBIOLOGICAL QUALITY OF MEAT

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Keywords: beef, food safety systems, *E. coli* serotypes

Introduction

In South Africa, there are two classes of high throughput red meat abattoirs, the export and the non-export abattoir. South Africa uses the Meat Safety Act (Act 40, 2000) and its regulations to administer the South African meat industry by providing a framework for developing meat hygiene and safety programmes, resulting in the assurance of wholesomeness and supply of quality meat to consumers. Standards and requirements at export abattoirs are more stringent and monitored by the Department of Agriculture (DoA).

Although all abattoirs have to meet structural and hygiene requirements, export abattoirs in addition have to meet the following:

1. A local high throughput abattoir wishing to export meat and meat products would have to apply and, if successful, would be registered as an export establishment.
2. The Department of Agriculture (National /Provincial) assigns a full-time veterinarian to be stationed at each export abattoir. The EU requires that such a veterinarian carries out ante-mortem inspection. The ante-mortem records will be incorporated into a traceability system.
3. Exporting abattoirs implement auditable HACCP systems.
4. Exporting abattoirs have a traceability system that covers the whole chain from farm-to-table.

The non-export abattoirs utilise an inspection system, which removes diseased and dirty animals from the food supply. Visual inspection by sensory methods such as smell, sight and sense of touch are relied upon to identify unsafe food. Such a system does not target and reduce microbial pathogens on raw meat. Since bacteria such as *E. coli* O157:H7 or *Salmonella* cannot be detected by visual inspection, they remain present in meat and poultry products delivered to distributors and consumers. This research focuses on the determination of total bacterial counts, and the incidence of *Pseudomonas* spp. *Enterobacteriaceae*, lactic acid bacteria (LAB) *E. coli* serotypes, *Salmonella*,spp and *Staphylococcus aureus* on fresh beef after chilling, produced from high throughput abattoirs with food safety systems and beef from high throughput abattoirs without food safety systems.

Materials and Methods

Two high throughput abattoirs participated in the project. Each abattoir was visited two times, where ten carcasses were randomly selected followed by the collection of 20 swab samples i.e. 40 samples per abattoir. Envirosponges (USDA) were used to swab a 25 cm^2 area on the right side of the carcass and a corresponding left fore quarter was swabbed for *Salmonella* analysis. The swab samples were kept cool (below 5°C) during transportation. 20 swab samples were processed at the University of Pretoria, whereas the remaining 20 were send to Onderstepoort Veterinary Institute for *Salmonella* analysis.

Laboratory evaluation: Each swab was homogenized in 225 ml 0.1 % Buffered Peptone Water (BPW) for 2 minutes. Serial dilutions were prepared with the use of a 0.1 % BPW (oxoid). The spread plate method was further applied (taking the dilution factor into consideration) to quantify the various microbial groups (Herbert, 1990) using the following agars: Standard Plate Count Agar (Oxoid-CM0463), (Martley *et al.*, 1970) followed by incubation at 25°C for 72 h; Pseudomonas Agar Base (Oxoid-CM0559) with added glycerol, followed by incubation at 25°C for *Pseudomonas* spp.; Bair-Parker Agar (Bio-Rad SA), followed by incubation at 35°C for 48 h for *Staphylococcus* sp.; MRS Agar (Biolab) followed by incubation for 48 h for Lactic Acid Bacteria and Violet Red Bile-Glucose (Oxoid) for *Enterobacteriaceae* followed by incubation at 37°C for 24 hours.

Results and Discussion

Table 1: Incidence of *Staphylococcus aureus* and *Salmonella* spp on fresh beef carcasses from high throughput abattoirs with (abattoir A) and without (abattoir B) food safety systems (n=20) after chilling (ND= not detected).

Abattoir	Visit	Number of samples positive (n=10)	*Staphylococcus aureus* (log cfu/g)	*Salmonella* spp.
A (HACCP)	1	6	2.09	ND
	2	7	1.11	ND
B	1	0	0	ND
	2	3	0.32	ND

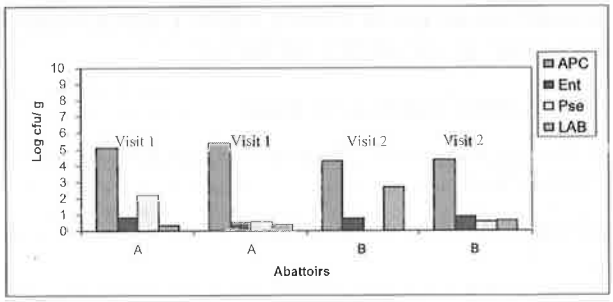

Figure 1: Incidence of target bacteria on fresh beef carcasses from high throughput abattoirs with (abattoir A) and without (abattoir B) food safety systems (n=20) (APC=Aerobic Counts, Ent = Enterobacteriaceae, Pse = *Pseudomonas* spp. and LAB = Lactic Acid Bacteria).

Table 2: Incidence of *E. coli* serotypes isolated during processing of fresh beef carcasses in high throughput abattoirs with or without food safety systems.

Abattoir	Processing step	*E. coli* O157:H7	*E. coli* serotypes
A (HACCP)	AE	+ (1/5)*	RPN
	AF	+ (1/5)*	RPN
	AC	-	RPN
B	AE	-	RPN
	AF	-	RPN
	AC	-	RPN

AE= After Evisceration; AF = After the final wash; AC = After Chilling; RPN = Rough non pathogenic.
*samples positive for *E. coli* O157:H7.

The Aerobic Plate Counts from abattoir A were high compared to abattoir B. A difference was observed in the Enterobacteriaceae counts from abattoir A compared to abattoir B (Figure 1), an indication that the Hygiene Management Systems used at abattoir B are effective in controlling carcass contamination during slaughtering. *Staphylococcus aureus* was present in 65 % of the samples collected from abattoir A compared to 30 % presence from abattoir B. Since abattoir A has an auditable food safety system, the high *Staphylococuss aureus* incidence indicates that the food safety system is not managed optimally. Twenty percent of samples at abattoir A tested positive for *E. coli* O157:H7 compared to none at abattoir B and higher APC and *Pseudomonas* spp. counts were recorded at abattoir A compared to B. Some researchers have suggested that *E. coli* O157:H7 has always been present in the abattoirs but is probably out competed for survival by other organisms and as such has not been able to grow sufficiently to cause foodborne outbreaks. It was further noted that in the US there has been more food borne outbreaks implicating *E. coli* O157:H7 since the inception of the Pathogen Reduction Programme. This programme involves the use of decontaminants which are not selective but may also eradicate the protective organisms. In South Africa only chlorinated water is used in the final wash. *Salmonella* was not detected in all the samples. In the FSIS's National beef microbiological baselines data collection programme (FSIS, 1994) the mean number of *Salmonella* was recovered from 1 % of 2,089 carcasses. In a study carried by the provincial department of agriculture in Northern Cape (not published), *E. coli* O157:H7 was isolated mostly from sheep and pork carcasses compared to beef carcasses.

Conclusion

The effectiveness of the food safety system at abattoir A for controlling microbial contamination of carcasses does not seem to be optimal.

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