Validation of Steam-Vacuum process as corrective measure for visible faecal contamination on carcasses: preliminary results.

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Abstract

The aim of this study was to evaluate the efficacy of Steam vacuum systems applied onto pork carcasses with visible faecal contamination. According to EU regulation visible faecal contamination on carcasses must be removed by trimming or alternative means having an equivalent effect. Existing steam-vacuum systems, developed and used in USA or Denmark, need to be tested and validated as an alternative to traditional knife trimming.

To assess the effect of the traditional and alternative treatments on carcasses with visible faecal contamination, two surface pooled samples were removed by destructive method prior and after treatments. For each sample, aerobic total counts and *Enterobacteriaceae* were enumerated and *Salmonella* presence tested. The result of final counts was also compared to freshly slaughtered carcasses counts (control). Steam-vacuum removed visible faecal contamination and reduced bacterial contamination to a normal level on the outside rind surface of the carcass. On the inside of the carcass, due to heat sensitivity of the meat surface, faecal contamination was reduced but still visible after treatment, and bacterial contamination was thus higher than with control carcasses. Therefore, additional experiments using other parameters of steam-vacuum are conducted to improve overall efficacy.

Introduction

According to EU regulation, visible faecal contamination on carcasses must be removed by trimming or alternative means having an equivalent effect. Existing steam-vacuum system, developed and used in USA or Denmark, need to be tested and validated as an alternative to traditional knife trimming.

This study proposed to evaluate the efficacy of steam vacuum system and knife trimming for the treatment of carcasses with visible faecal contamination. According to the results, the slaughterhouse will be able to justify the use of either steam vacuum or knife trimming in the implementation of HACCP plan and exportation agreement audit.

Materials and methods

In order to simulate an accident of evisceration, faeces were collected in plastic box of 5 rectums of slaughter pork. The inside and outside surface of belly area, for the both sides of carcasses, was covered with the pooled caecal content with a sponge. After 10 minutes of contact time, one half of the carcass was knife-trimmed and the other one was treated by the steam vacuum system. The steam vacuum procedure consisted of an application of the suction head with steam at 90°C and 4 bars during 15 seconds.

Bacterial contamination was evaluated on carcasses prior (contaminated) and following treatments. For each carcass one 25cm² sample tissue was excised from the outside (Rind) and the inside (Meat), prior and after treatments. At the same time on the slaughter line, carcasses without visible faecal contamination were also sampled, to be used as control of bacterial contamination.

Aerobic colony counts (ACC) and *Enterobacteriaceae* (ENT) were performed by spiral-plating of sample of rind and meat for each carcass; *Salmonella* presence was also tested on the treated carcasses. For enumeration of Aerobic colony counts, diluted stomachates were inoculated on PCA during 48h at 30°C (NF V08-51) and on VRBG during 24h at 30°C (NF V08-54) for *Enterobacteriaceae.* The Bioline Salmonella Elisa Test OPTIMA was used for *Salmonella* presence, and positive results were confirmed with ISO 6579 method.

For enumeration, the limits of detection were < 400 CFU/cm² and < 4 CFU/cm² for respectively ACC and ENT. For each treatment, 15 carcasses were tested in 3 trials. The efficacy of decontamination: it is the difference between faecal contaminated carcasses and carcasses after treatment.

Data were analysed using the 8.02 SAS software version (SAS Institute, USA). Most of the results counts were below the sensitivity limit, no quantification could thus be made. For preliminary data analysis, the comparison of results below the sensitivity limit between treatments was performed using a basic Chi-square test.

Results and discussions

Table 1 presents the average levels of bacterial contamination, counts below the enumeration threshold were replaced by the value of the threshold. Whereas further statistical investigation are presently conducted to allow a proper analysis, it seems that the ACC and ENT counts of manually contaminated carcasses with faecal contamination are respectively 2 and 3 log higher than for the control.

During this study, the presence test for *Salmonella* produced too few positive for a statistical analysis. The presence for faecal contaminated carcasses was 4% (2/45) on rind and 13% (6/45) on meat. The *Salmonella* contamination was natural and not homogeneous. After treatment, the presence was 0% (0/45) and 2.2% (1/45) respectively for trimming and Steam-vacuum system.

Table 1. Means of contamination (log_{10}CFU/cm²) between treated carcasses and naturally contaminated carcasses

	Rind		Meat	
	ACC	ENT	ACC	ENT
Contaminated carcasses	5.49	4.93	5.24	4.22
Control carcasses	3.26	1.90	3.06	1.00
Trimming	2.80	1.54	2.97	1.61
Steam vacuum	2.67	1.34	3.15	1.78

Table 2. Efficacy (log_{10}CFU/cm²) of treatments on faecal contaminated pork carcasses

	Rind		Meat	
	ACC	ENT	ACC	ENT
Trimming	2.69	3.39	2.27	2.60
Steam vacuum	2.82	3.59	2.10	2.53

The level of contaminated carcasses was superior to control carcasses (+ 2 Log_{10}CFU/cm² for ACC and + 3 Log_{10}CFU/cm²). The efficacy of treatments (Table 2) was underestimated with substitution of counts below the enumeration threshold by the value of the threshold. However, the results agree with the results of Phebus et al. (1997) who obtained a reduction on beef meat of 2.5 Log_{10}CFU/cm² for trimming and 3.7 log_{10}CFU/cm² for « Steam pasteurization », the initial pathogens contamination was 5 log_{10}CFU/cm². And the results were according with Purnell and al. (2005) that indicated an efficacy of decontamination after steam treatment on beef cuts of 1.8 log_{10}CFU/cm² for ACC and all ENT counts were under limit of detection. Both treatments were performed to reduce the contamination on faecal contamination carcasses on rind and meat.

The proportion of result under detection was 52% for ACC and 24% for ENT on rind. For meat the proportion were respectively 43% and 34% for ACC and ENT.

Table 3. Repartition (%) of results on rind

	ACC			ENT		
	<400	>400	*	<4	>4	*
contaminated carcasses		100	**A**		100	**A**
control carcasses	44	56	**B**	13	87	**A**
trimming	69	31	**B**	38	62	**B**
steam vacuum	96	4	**C**	44	56	**B**

Table 4. Repartition (%) of results on meat

	ACC			ENT		
	<400	>400	*	<4	>4	*
contaminated carcasses		100	**A**		100	**A**
control carcasses	58	42	**B**	62	38	**B**
trimming	56	44	**B**	38	62	**B**
steam vacuum	58	42	**B**	38	62	**B**

*** A,B,C,D** Proportion within a column sharing the same letter are not significantly different (p>0,05).

When comparing the contamination after treatments with normal carcasses, the level after treatments was significantly lower or equal of control carcasses. Steam-vacuum treatment for ACC on rind (Table 3) was significantly superior of knife trimming. On meat, the both treatments were not significantly different (Table 4).

These results showed the decontamination efficacy of knife trimming for faecal contaminated carcasses treatment. These results were in contrast to the result of Gill and al. (1997) that indicate no reduction of ACC for contaminated pork after knife trimming. With knife trimming, all contaminated rind surface and a large part of sparerib was removed, the carcasses were unacceptable for sell. Whereas with steam-vacuum treatment, the rind was preserved; and after lightly trimming the heat meat surface, sparerib gave back a normal appearance.

Conclusions

The results obtained in this study suggest that steam-vacuum system can be used onto pork carcasses with visible faecal contamination and be incorporated in HACCP procedures. The steam-vacuum system had an equivalent decontamination effect of trimming. Additionally, the carcasses were less damaged than trimming.

References

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