On-site validation of thermal treatments used as corrective actions on pork carcasses and cuts

A. Le Roux*, B. Minvielle & A. Vallée
IFIP – French Institute for Pig and Pork Industry, La motte au Vicomte, BP 35104, 35561 Le Rheu Cedex, France.
*E-mail : alain.leroux@ifip.asso.fr

Abstract

Since the implementation in 1994 of HACCP principles pork meat industry has developed some corrective actions. The aim of this study was to validate the bacterial efficacy of thermal treatments used in slaughterhouses and cutting rooms as corrective measures. We studied 3 existing heat treatments applied onto pork carcases and meat cuts in 4 plants. For each treatment a few couples of distance and duration parameters were preliminary tested to avoid non reversible heat damages. To validate the effect of the treatments and distance-duration couples, adjacent meat surface samples of 25 cm² were obtained by the destructive method before and after treatment, and aerobic colony counts and *Enterobacteriaceae* were enumerated. Most of the results of *Enterobacteriaceae* counts were below the sensitivity limit; whereas no quantification could be made, contamination was significantly lower after heat treatment. The bacterial reduction for aerobic colony counts was significantly lower on meat surfaces of cuts than on the rind surfaces of carcases or cuts (0.2-1.5 vs. 0.8-2.4 Log), due to their higher heat sensitivity. Heat process without flames should be recommended for meat cuts, whereas flames processes should be used for carcases. All thermal treatments were quick (2-6 s) and easy to use.

Introduction

Since the implementation in 1994 of HACCP principles pork meat industry has developed some corrective actions. The aim of this study was to validate the bacterial efficacy of thermal treatments used in slaughterhouses and cutting rooms as corrective measures. The heat treatments with or without flames were tested for process to avoid non reversible heat damages. The processes should be easy to use. To validate the effect of the treatments, some distance-duration couples were retained by process. For each process and couples the bacterial reduction was explored.

Materials and methods

In each plant, the process was applied onto pork carcasses and shoulders on the two-side lateral (rind) and medial (meat). Three slaughterhouses use a process with flame: two have a blowtorch (BT) [Ripack 2000], and one has a gas burner (GB) [a bottled gas with large flame]. The last plant uses an electric paint burner (PB): Leister Electron 2A; this process was only used for meat cuts treatment (Table 1).

Three existing heat treatments were tested in 4 French slaughterhouses. For each treatment 3 couples of distance and duration parameters were studied. The couple was classified according to the surface temperature during the process (distance=15 to 25 cm and time=3 to 6 seconds). The treatment number 1 corresponded of the higher heat on surface, the number 3 the less heat and the number 2 intermediary (Table 2).

Table 1. Materiel by slaughterhouses (A,B,C,D) according to pieces

	Carcases	Shoulder rind	Shoulder meat
GB	C,D (65)	D (48)	D (54)
BT	A,B (48)	A,B (36)	A,B(36)
PB		C (36)	C (36)

() Size of tested population
GB: gas burner; WT: welding torch;
PB: paint burner

Table 2. Distance and time for each treatments

	Treatment	Carcasses	Shoulder rind	Shoulder meat
		Distance (cm) / Time (s)		
GB	1	8 / 3	15 / 3	5 / 1.5
	2	15 / 3	20 / 6	8 / 3
	3	20 / 6	15 / 2	20 / 3
BT	1	15 / 2	20 / 3	5 / 2
	2	20 / 3	25 / 3	10 / 2
	3	25 / 3	25 / 3	15 / 3
PB	1		3 / 5	4 / 2
	2		3 / 3	7 / 4
	3		5 / 5	7 / 2

Bacterial contamination was evaluated on treated carcasses and meat cuts prior and following treatments. Sampling (25 cm²) for bacteriological examination was carried out by an excision technique. Both samples, before and after treatment, were excided side by side. For enumeration of Aerobic colony counts, diluted stomachates were inoculated on PCA during 48h at 30°C (NF V08-51) and for *Enterobacteriaceae* on VRBG during 24h at 30°C (NF V08-54).

Means of bacterial reductions (log_{10}CFU/cm²) for each treatment were calculated from 2 repetitions by plant. One repetition consisted in 6 carcasses and 6 shoulders of two sides (rind/meat) by treatment.

Statistical analysis was performed using the GLM procedure of 8.02 SAS software version (SAS Institute, USA).

Results and discussions

The efficacy of decontamination is negatively linked to the initial contamination greater reductions are achieved with the highest initial contaminations. The initial level contamination was not statistically independent of plant and type of treated surface (carcass, cuts).

The main effect influencing the decontamination was equipment (BT, GB, PB), the other parameters were less or not significant. Bacterial reduction was also influenced by treatment, which is dependent of the equipment.

Most of the *Enterobacteriaceae* counts were below the sensitivity limit; no bacterial reduction calculation could thus be made. However, a basic comparison between results below the sensitivity limit between prior and following treatment (65% *vs.* 90%) showed that the bacterial contamination was significantly lower after heat treatments (Chi-square test; $p \leq 0.0001$).

Means of ACC reductions (log_{10}/cm²) were calculated for treatments (Table 3,4,5).

Table 3. Reduction of ACC (log_{10}/cm²) according to equipments and treatments on carcases

Treatments	Carcases	
	GB	BT
1	1,8 a*	2,4 a
2	1,9 a	2,3 a
3	0,8 b	2,4 a

* $^{a,b,\ldots}$LSmeans sharing the same letter are not different ($p>0,05$)

The bacterial reduction for aerobic colony counts was equivalent between the two equipments (1,8 to 2,4 log_{10}/cm²) for carcasses.

The treatment 3 with GB was significantly lower, the distance (20 cm) between carcasses and GB limiting heat effect for bacterial reduction.

Table 4. Reduction of ACC (log_{10}/cm^2) according to equipments and treatments on rind
* [a,b,...]LSmeans sharing the same letter are not different (p>0,05)

Treatments	Shoulders rind		
	G B	B T	P B
1	0,5 bc	2,0 a	2,1 a
2	0,8 b	2,2 a	2,1 a
3	0,0 c	2,1 a	1,7 a

Table 5. Reduction of ACC (log_{10}/cm^2) according to equipments and treatments on meat.
* [a,b,...]LSmeans sharing the same letter are not different (p>0,05)

Treatments	Shoulders meat		
	G B	B T	P B
1	0,2 ef	1,5 a	1,0 abc
2	0,5 cde	0,8 bcd	0,5 cdef
3	0,0 f	1,4 ab	0,6 cde

The gas burner treatment had a significantly lower reduction on the rind surfaces of cuts than the other equipments. The decontamination of welding torch and paint burner was 2 log_{10}/cm^2 and the treatments were not significantly different.

The reduction obtained on meat surfaces with gas burner treatment was significant lower than the two others treatments. The duration of treatments were 2 seconds maximum; a longer duration caused heat damages requiring knife-trimming.

The efficacy of welding torch and paint burner were 1 log_{10}/cm^2, the treatments were less efficient than on carcasses and rind cuts. The durations were short and thus the temperatures on the surface were insufficient for bacterial reduction.

We were not able to record and analyse the surface temperatures because of the short time of treatments.

Conclusions

Heat process without flames should be recommended for meat cuts, whereas flames processes should be used for carcasses. The paint burner had equivalent efficacy than the process with flame, but its use is safer and preserves product appearance. All thermal treatments were quick (2-6 s) and easy to use**.** The couple for each process could be used as reference for industry. The measure of heat on surfaces has to be studied for optimisation of use conditions.

References

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