



# Steam for decontamination

**Lene Meinert & Jens P. Teilmann, Food Safety & Quality**

Traditionally, visible contamination on carcasses has been removed by trimming with a knife. An alternative steam vacuum treatment is now commonly used in abattoirs in several countries for the removal of contaminants on carcasses. In Denmark and in the US, steam vacuum has been used for more than 30 years.

In Table 1, results from tests performed by the Danish Meat Research Institute (DMRI) are presented, showing a 1 log reduction (total viable count) on average after steam vacuum treatment of visibly contaminated areas.

The French Pork and Pig Institute (IFIP) performed a comparison test between steam vacuum and trimming and concluded that the two methods were equivalent in decontamination effect. Furthermore, the steam vacuum treatment was less damaging to the carcass compared to trimming (1).

## The effect of steam vacuum treatment

Several tests have been conducted by the DMRI throughout the years using the specially developed nozzles. The results are summarized in Table 1. On average, steam vacuum treatment provides a 1 log reduction of the total viable count. Furthermore, in a study with cattle (2) the prevalence of *Escherichia coli* on beef carcasses was reduced from 51% to 7% positive samples, after treating with steam vacuum.

**Table 1.** The effect of steam vacuum treatment on beef, pork, and lamb carcasses measured as a reduction in total viable count (the column "reduction"). "Incubation" refers to the conditions used for the bacterial analysis.

	Total viable count (log CFU/cm <sup>2</sup> )				
Type of meat	Before steam	After steam	Reduction	Ref.	Incubation
Beef, hind thigh	3.2 (n=180)	1.9 (n=90)	1.3	(2)	PCA 30°C/3 days
Beef, chest (day 1)	3.5 (n=10)	2.2 (n=10)	1.3	(4)	PCA 30°C/3 days
Beef, chest (day 2)	3 (n=14)	1.2 (n=14)	1.8	(4)	PCA 30°C/3 days
Pork, chest (day1)	1.57 (n=30)	0.66 (n=30)	0.91	(3)	Petrifilm 37°C/2 days
Pork, chest (day 2)	2.18 (n=30)	1.02 (n=30)	1.16	(3)	Petrifilm 37°C/2 days
Pork, abdominal cavity (day 1)	1.88 (n=30)	0.54 (n=30)	1.34	(3)	Petrifilm 37°C/2 days
Pork, abdominal cavity (day 2)	1.58 (n=30)	0.73 (n=30)	0.85	(3)	Petrifilm 37°C/2 days
Lamb, chest (day 1)	2.6 (n=50)	1.5 (n=50)	1.1	(4)	PCA 30°C/3 days
Lamb, chest (day 2)	2 (n=50)	0.5 (n=50)	1.5	(4)	PCA 30°C/3 days

PCA: Plate Count Agar, Petrifilm: 3M™ Petrifilm™ Rapid Aerobic Plate Count.

### Steam vacuum vs. trimming by knife

Comparison tests conducted by DMRI showed that removing contaminations with steam vacuum proved more effective than trimming off the contaminated area with a knife. Tests on beef and pork carcasses showed that carcass areas treated with steam vacuum had a lower bacterial count than carcasses where the contaminated areas were trimmed off (2,5). Ten seconds of steam vacuum treatment on beef carcasses reduced the bacterial count by 1.3 log CFU/cm<sup>2</sup>, while trimming only reduced the bacterial count by 0.5 log CFU/cm<sup>2</sup>.

### Steam vacuum systems

The principle behind the steam vacuum system is that the contamination is removed by vacuum while steam continuously disinfects the nozzle and thereby prevents cross contamination of the carcasses (6). DMRI has developed two nozzles for the treatment of carcasses, which can be used with either a permanent steam installation or a mobile solution.



Classic nozzle



Tubular 5 nozzle

### Removal of protein contaminations

In the rare case of allergen concerns (milk from the cow udder contaminating meat cuts), a test was performed to determine if the concentration of allergen contaminants (casein) could be reduced by steam vacuum treatment.

In the model test set-up, aliquots of cow milk were distributed (0.015 ml/cm<sup>2</sup>) on 10 pork belly cuts. Five cuts were steam vacuumed and five were untreated (controls). The skin was analysed for the presence of the milk protein casein. The skin of the control pork cuts contained an average of 198 mg casein/kg, while the steam vacuumed cuts only contained 4.4 mg casein/kg. Thus, the steam vacuum treatment reduced the concentration of casein by 97.8%, and thus greatly reduced the risk of allergic reactions (7).

### Approval

The approval by national authorities to use steam vacuum in the slaughter process differs between countries. In Denmark and the US, steam (vacuum) is described as a means of handling e.g., manure contamination as an alternative to trimming off the contaminated area in the national guidelines:

**Denmark.** The Danish Veterinary and Food Administration <https://foedevarestyrelsen.dk/lovstof/vejledninger/hygijnevejledningen>

US. United States Department of Agriculture (USDA), The Food Safety and Inspection Service. ([Handling \*E. coli\* contamination during slaughtering of cattle](#)). ([Handling of \*Salmonella\* during the slaughtering of pigs](#)).

Other countries may have other rules. Spain is one example. To obtain an approval of using steam vacuum for removal of contamination in Spanish slaughterhouses, an application for the usage of steam vacuum must be evaluated by The Spanish Agency for Food Safety and Nutrition ([AESAN](#)).

## References

1. Le Roux, A., Minvielle, B. Validation of Steam-Vacuum process as corrective measure for visible faecal contamination on carcasses: preliminary results. ICoMST, 54<sup>th</sup> International Congress of Meat Science and Technology. Cape Town, South Africa. Proceedings; 2A-12, 3p. 2008.

Test reports (Danish):

2. Dalsgaard B., Teilmann J., Christensen H. Steam Vacuum System – Afprøvning og dokumentation af damp suger på slagtelinjen på et dansk kreaturslagteri. 2003.
3. Hansen F. Dekontaminering – Nyt udstyr – Indledende test af damp sugning (12-finger) på hel slagtekrop. 2006.
4. Steenberg B., Teilmann J., Christensen H. Damp sugning af lammeslagtekroppe – forbedring af mikrobiologisk kvalitet på bryst af slagtevarmt småfe og storfe. 2006.
5. Tarp C. Fjernelse af gødningsforurening med kniv eller damp sug – Reduktion af *E. coli* og total kim ved renskæring med kniv vs. damp sugning. 2004.
6. Jensen T., Christensen H. Sterilisationsudstyr – Sugehoved med kontinuerlig damp tilsætning – mikrobiologisk verificering. 2001.
7. Lüthje F., Svenningsen N.B., Koch A.G. Somælk på sværoverflader – Allergen reaktion, effekt af damp sugning. 2021.

## Want to learn more?

The nozzles and the mobile steam vacuum system can be purchased through DMRI webpage.

Papers on the use of steam as decontamination:

Meinert, L. (2023) Steam for decontamination. Fleischwirtschaft int. nr 3, p. 32

Meinert, L., Sigtryggsson, B. (2022) Produkthygiene optimieren. Fleischwirtschaft. 1, s. 34

Meinert, L., Sigtryggsson, B. (2020). Optimer hygiejnen i produktionen nemt og effektivt med mobilt damp sug. Plus Proces nr. 5, s. 14

Meinert, L., Sigtryggsson, B. (2021). Mobilt damp sug anlæg optimerer hygiejnen. Teknisk Nyt nr. 3 s. 29

Meinert, L., Sigtryggsson, B. (2020). Optimer produksjonshygien. Kjøttbransjen 6, s. 30