DECONTAMINATION INTERVENTIONS OF EDIBLE BYPRODUCTS FROM SHEEP

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Abstract - Norwegian abattoirs have introduced different decontamination interventions for edible byproducts from sheep used for dry fermented sausages. The aim of the study was to investigate the effect of heat treatments of both steam and hot water pasteurisation, and also the effect of cold water bath after the heat treatment. Included in the study were 126 hearts and 60 diaphragms from sheep. Both steam and hot water pasteurisation lasted for 40 s ± 3 s. The products were sampled at three sites in two commercial abattoirs; directly from the slaughter line before heat treatment, after heat treatment, and subsequently from cold water bath. The products were analyzed as pooled samples. The results showed that there was a small reduction in *Escherichia coli, Enterobacteriaceae* and aerobic plate count (APC) after decontamination treatment with steam on hearts and hot water pasteurisation on diaphragms, but the differences were not significant. The number of pooled samples was small and a new study with a larger number of samples is planned.

I. INTRODUCTION

In Norway, edible byproducts from sheep such as hearts and diaphragms have been widely used in dry fermented sausages. In 2006, an E. coli O103:H25 outbreak occurred in Norway. Dry fermented mutton sausages were found to be the vehicle of infection. One child died and 17 children became ill, most of them with symptoms of haemolytic-uraemic syndrome (HUS). After this outbreak, the meat industry has been cautious with using sheep byproducts in dry fermented sausages. Dry fermented products are normally not heat-treated before consumption, and thus might involve a larger risk for food poisoning. During the last few years some abattoirs have introduced decontamination interventions of the sheep byproducts after they are separated from the carcasses on the slaughter line. Both steam and hot water are used for decontamination before freezing of the products. The effect of the decontamination interventions has not been investigated and published in Norway and we have not been able to find international studies on edible byproducts and offal from sheep. The aim of this study was to investigate the effect of steam and hot water pasteurisation of hearts and diaphragms from sheep and subsequent cold water bath.

II. MATERIALS AND METHODS

The study was performed in two commercial abattoirs in October 2013. The abattoirs used different slaughter techniques. In abattoir A, the carcasses were suspended by the forelegs during evisceration, and rodding of oesophagus was not performed, as the oesophagus was cut just above the diaphragm. In abattoir B, rodding of oesophagus by a clip and bagging of rectum in a plastic bag were performed while the carcasses were hanging by the hind legs.

The hearts and diaphragms included in the study were sampled from the slaughter lines as the products were removed from the plucks. The slaughter line speed in both abattoirs was approximately 250 sheep per hour.

In abattoir A, steam was used for decontamination of hearts for 40 s ± 3 s. The hearts were put on a metal net band that transported them into a cabinet with steam nozzles. On the other side of the cabinet, the hearts dropped into a cold water bath. In abattoir B, both hearts and diaphragms were decontaminated for 40 s ± 3 s. Abattoir B used a cabinet with hot water deluging the byproducts hanging on hooks on a conveyor. In the end of the cabinet cold water was sprayed on the by products. The product then fell into a cold water bath. In both abattoirs the byproducts were taken from the cold water baths and frozen into 20 kg

blocks and sold to dry fermenting sausage manufacturers.

In both abattoirs 20 hearts were sampled before heat treatment and another 20 hearts after heat treatment. In abattoir B also 20 diaphragms were sampled before and another 20 diaphragms after heat treatment. From the cold water baths 10 hearts untreated and 10 heat-treated were sampled and in abattoir B also 10 diaphragms untreated and heat treated were sampled from cold water baths. The samples were stomached for 30 s with sterile peptone water. Pooled samples of five were analyzed for APC on pour plate agar by NMKL method No. 88, and *Enterobacteriaceae* by NMKL method No. 144 [1]. *E. coli* was analyzed by SimPlate Coliforms & E. coli (BioControl Systems Inc, Bellevue, WA, USA)

Sensors for temperature logging were attached to the products as they were transported through the cabinets. Also temperature reductions in the cold water baths were logged.

Stata IC version 12 for windows (StataCorp, College Station, Texas) was used for statistical analyses. Descriptive statistics were performed and differences between groups were tested by t-tests. The level of significance was set at $P \leq 0.05$.

In abattoir A, a pilot study was performed which included three hearts before heat-treatment and three hearts after treatment. The heat treatment in a steam cabinet was similar to the description of the main study.

III. RESULTS AND DISCUSSION

The results from the study of steam decontamination of sheep hearts in abattoir A, showed a small reduction of APC, *Enterobacteriaceae*, and *E. coli.* However, the differences were not significant. A pilot study with three hearts heat treated and three hearts untreated in abattoir A were included in Figure 1.

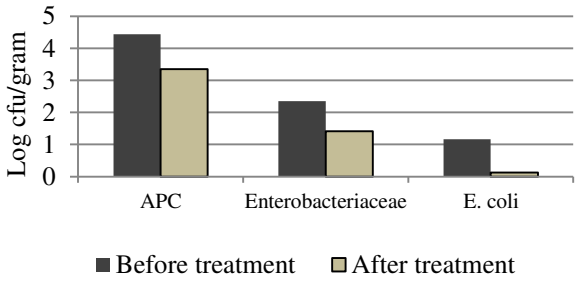

Fig. 1. Results for hearts before and after steam treatment in a cabinet in abattoir A. Results from a pilot study was included (n=3 in each group) so the total number of samples both before and after heat treatment was 23.

In abattoir B there was no difference in the levels of APC, *Enterobacteriaceae, and E. coli* between the hearts with and without hot water pasteurisation.

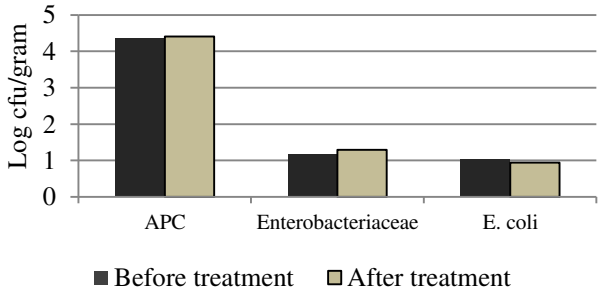

Fig. 2. Results for hearts before and after hot water pasteurisation in a cabinet in abattoir B.

Logging of the air temperature in the cabinets in abattoir A and B showed a temperature of 80-90 °C. When logging the heart temperature, the sensor was attached immediately under the surface, showing a maximum temperature of approximately 61 °C in abattoir A and 55 °C in abattoir B.

The maximum temperature on the surfaces of the hearts was lower in abattoir B than abattoir A (approximately 6 degrees lower). This might be due to the positions of the nozzles spraying hot water only at the lower part of the hearts. The cabinet was made of steel and it was not possible to see the spraying of water.

The diaphragms had a larger difference in microbial contamination between groups treated and not treated with hot water pasteurisation. But the differences were not significant. The diaphragms were hanging on the same hooks on the conveyor in the cabinets, but they had a larger size and thus hang much lower. The hot water spraying out of the nozzles might hit the diaphragms better than the hearts.

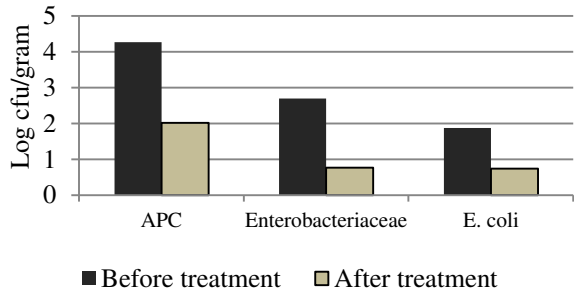

Fig. 3. Results for diaphragms before and after hot water pasteurisation in a cabinet in abattoir B.

The difference in slaughter method between abattoir A and B might affect the contamination level of the hearts. There is assumed that abattoir A has a higher risk of contamination of hearts than in abattoir B, because rodding of oesophagus was not performed. A small pressure on the rumen can push the rumen content out and contaminate the hearts and other offal. The results are therefore expected to vary widely in bacterial levels from sample to sample in abattoir A. However, the results from hearts before heat treatment in abattoir A showed that the initial contamination level was the same as in abattoir B.

IV. CONCLUSION

The results showed a tendency of a reduction of contamination measured by APC, *E. coli,* and *Enterobacteriaceae* on sheep hearts by application of steam pasteurisation and on sheep diaphragms by application of hot water pasteurisation in cabinets. However, the number of pooled samples was low and there were no significant differences between groups of treatment. A new study with a larger number of samples is needed, to get more reliable results.

ACKNOWLEDGEMENTS

We wish to thank the local staff in the two abattoirs were the study was performed. Funding was mainly provided by the Research Council of Norway and Foundation for Research Levy on Agricultural Products.

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1. Nordic committee on food analysis, 2005. *Enterobacteriaceae*, 3rd ed. Determination in Foods and Feeds, No. 144, Norway.