PREDICTING THE RISK OF HIDE CROSS-CONTAMINATION IN THE CATTLE LAIRAGE DURING HOLDING PRIOR TO SLAUGHTER

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Background

Foodborne pathogens carried asymptomatically in the intestines of cattle can be found on the hides of these animals [1], and pose a significant risk of contamination of the subsequent carcass during the slaughter and dressing procedure[2]. Similarly, spoilage organisms present on the hide can be transferred to the carcass during harvest [3]. Although only a small proportion of animals arriving at the abattoir may be contaminated with significant pathogens, extensive cross-contamination can occur during the holding period [4]. Understanding of the factors affecting the rate of transfer of micro-organisms between animals could assist in developing a risk-based strategy to minimise the spread of foodborne pathogens during the pre-slaughter phase, thus minimising the risk of contamination of carcasses processed in the abattoir.

Objectives

This study aims to evaluate some factors affecting cross-contamination during the holding period prior to slaughter in the commercial cattle abattoir.

Materials and methods

91 groups of cattle were observed continuously throughout the holding period at a large commercial beef processing plant in the Southwest of England. One focal animal in each group was selected and each incident of contact between that animal and either the vertical structures of the holding pen or another animal within the group was recorded, in five-minute blocks throughout the holding period, a minimum of 30 minutes. Group size ranged from 1 to 18 animals, held in pens of 24 m^2 to 30 m^2, giving space allowances ranging from 1.88 m^2 to 26 m^2 per animal. The result sets were grouped into low ($\leq$ 2.5 m^2 per animal), medium (2.5 $\leq$ 5 m^2 per animal) and high (>5 m^2 per animal) stocking density and the number of contacts over time analysed by ANOVA using MINITAB Statistical Software.

Results and discussion

Over the 30-minute holding period, at all stocking densities, total number of contacts affecting the focal animal in each 5-minute block declined. At all stocking densities, the numbers of contacts with the vertical structures of the pen did not significantly decline over time, and there was no significant difference in the numbers of wall contacts occurring per time block between each stocking density. At medium and high stocking densities there was a significant difference between animal activity in the first ten minutes of holding and in the subsequent period, by comparing average contacts per animal per minute (ACAM) (Table 1). There was also a significant difference in ACAM over all time periods between stocking densities, animals at low stocking density experiencing fewer animal-to-animal contact incidents than animals at medium stocking densities, which in turn experience fewer animal-to-animal contact incidents than animals at high stocking densities. The relationship between ACAM over a 30-minute period ($ACAM_{30}$) and space allowance was not linear, whilst plotting $ACAM_{30}$ against $\log_{10}$ space allowance showed two distinct lines of best fit, one associated with medium to high stocking density, the other associated with low stocking density. Linear regression analysis of the line of best fit associated with low stocking density identified that to achieve no animal-to-animal contacts, each animal would require a space allowance of 17.22 m^2, whereas linear regression analysis of the line of best fit associated with medium to high stocking densities suggested that a space allowance of 4.22 m^2 would lead to no animal-to-animal contacts.

Conclusions

It is likely that each physical contact of animals with lairage's structures and other animals results in some extent of transfer of microbial contamination, if one of hides/contact surfaces is contaminated. During the holding period at the lairage, contact between a beef animal and the structure of the holding pen is inevitable. Furthermore, micro-organisms remaining on the pen walls when one group of animals is removed are likely to be transferred to animals' hides in subsequent groups of cattle. Contact between animals does increase with restricted space allowance, but to eliminate the risk of animal-to-animal transfer of micro-organisms, each animal would require a substantial amount of space. Animal interactions at low stocking densities differs from that at medium to high stocking densities, those at lower densities maintaining a level of interaction over the entire lairage holding period, whilst animals at medium to high stocking densities appear to settle down after the initial ten-minute period, reducing interactions. Use of ACAM factors could assist in predicting the risk of hide cross-contamination during the holding period, by estimating the numbers of contacts that would occur in a group of animals at a particular stocking density, over a set period of time. As the hide contamination is a key factor for carcass contamination, this would be the first step in risk-assessment-based identification and development of best strategies to improve meat safety through controls of hide contamination.

References

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Table 1 – Average contacts per animal per minute at different stocking densities

Average Contacts per Animal per Minute (ACAM)	Contact Type	Space Allowance per animal		
		≤ 2.5 m^2	$2.5 \leq 5$ m^2	>5 m^2
First 10 minutes ($ACAM_{10}$)	animal-animal	12.55	6.9	1.81
	animal-wall	0.99	1.1	1.11
Subsequent Period	animal-animal	8.17	4.66	2.13
	animal-wall	0.60	0.44	0.56
Over entire 30 minutes ($ACAM_{30}$)	animal-animal	9.63	5.33	1.71
	animal-wall	0.73	0.66	0.72