THE FATE OF *ESCHERICHIA COLI* O157, *SALMONELLA KEDOUGOU* AND *CAMPYLOBACTER JEJUNI* ON SURFACES COMMONLY PRESENT IN THE CATTLE LAIRAGE ENVIRONMENT

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Background

Healthy cattle are a reservoir for the major foodborne pathogens *E. coli* O157, *Salmonella* spp and *Campylobacter* spp (3), and these organisms may be transferred onto the meat during slaughter and dressing of the carcases (7). In the chain from farm to slaughter the lairage period is a potentially significant area in the cross contamination of animals with foodborne pathogens (8), and has been found to harbour *E. coli* O157, *Salmonella* spp and *Campylobacter* spp within the environment, despite routine cleaning measures being carried out (4, 5). Although numerous studies have been carried out to ascertain the survival of *E. coli* O157, *Salmonella* spp and *Campylobacter* spp in manure in storage and when spread onto pasture (2, 6), there is little information on their persistence in the immediate pre-slaughter environment, and indeed on the coats of cattle presented for slaughter.

Objectives

The main goal of the study was to assess the fate (survival or growth) of three major foodborne pathogens *E. coli* O157, *Salmonella* spp. and *Campylobacter* spp. on various substrates/surfaces, that are commonly present in the lairage of commercial cattle abattoirs, under simulated environmental conditions that may be encountered in animal holding facilities during warm or cold seasons.

Methods

Cattle faeces were collected and first screened for the presence of *E. coli* O157, *Salmonella* spp. and *Campylobacter* spp. The faecal matter free from these pathogens was subsequently inoculated with a mixture of non-pathogenic *E. coli* O157, *Salmonella kedougou* and a bovine strain of *Campylobacter jejuni.* The resultant mixture was then placed (1 gram amounts) on pieces of the five test surfaces: washed cattle hide; concrete block; galvanised steel; painted metal and straw ("dirty" surfaces). The inoculated samples were then placed on two series of trays a) one also containing a 400 cm^2 cellulose sponge that had been soaked in tap water (to create high air humidity) and b) another also containing 40 g of silica gel (to create low air humidity). Each tray (16 per series) was sealed into a large stomacher bag to ensure that the air humidity achieved is stable. The air humidity was regularly checked by placing a humidity meter into control packages with trays containing either wetted sponge or silica gel. The above protocol was repeated in identical manner but by inoculating pieces of the five test surfaces (washed cattle hide; concrete block; galvanised steel; painted metal and straw) with a mixed broth culture of the three test organisms (0.1ml per sample) so to simulate "clean" (faeces-free) surfaces. One set of packaged trays (containing all samples indicated above) was stored under "warm" conditions at 25°C and another set at 10°C ("cold"; results not shown). One tray of each of cold/dry, cold/wet, warm/dry and warm/wet was removed from the incubators at time zero, and then at 24 hour intervals until day 7. In each sample, the levels of *E. coli* O157, *Salmonella kedougou* and *Campylobacter jejuni* were determined using standard methods. The bacterial counts were expressed as means from triplicate samples.

Results and Discussion

The results are presented in Table 1. There was a general trend for the levels of each of the three organisms to significantly decline over a period of 7 days. Relatively rarely, certain increases in bacterial numbers were observed under some conditions. Straw supported growth of *Salmonella kedougou* and *E. coli* O157 under warm and clean conditions, and *E. coli* O157 under dry and dirty conditions. Under dry and clean conditions, *Campylobacter jejuni* was not detectable after 24 hours on any surface other than hide, *Salmonella kedougou* was not detectable after 24 hours on concrete, and *E. coli* O157 was not detectable after 24 hours on metal and painted metal. The only case where an increase in *Campylobacter* counts was observed, on faecally contaminated hide, is difficult to explain, as it is generally considered that at 25°C the pathogen cannot grow (1) Overall, decreases in bacterial numbers were more likely to be significant on metal, concrete and painted metal, while hide and straw seems to comparably enhance survival rates of the pathogens i.e. show certain protective effects.

Concluding remarks

The results indicate that pathogens *E. coli* O157, *Salmonella* and *Campylobacter* may remain viable on surfaces in the lairage environment for days and in many cases for longer than a week. The presence of straw in the lairage may enhance overall survival of the pathogens in lairage environment, and the pathogens can survive on cattle coats for days. Generally, the survival rates of the pathogens are significantly higher on surfaces visually contaminated with faecal matter, which underlines the relevance of regular and efficient lairage cleaning/sanitation for at-abattoir epidemiology of foodborne pathogens.

Pertinent Literature

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Table 1: Assessment of fate of pathogens on various surfaces in lairage environment at 25°C

Pathogens	Air humidity	Substrate status	Change in pathogens' populations (log CFU)[A] on various substrates				
			Metal	Painted metal	Concrete	Straw	Hide
Salmonella kedougou	Low[B]	Dirty[D]	-1.17 ** (day 7)[F]	+0.19 * (day 7)	-2.43 * (day 7)	-0.27 * (day 7)	+0.04 (day 6)
		Clean[E]	-6.07 (day 7)**	-6.58 * (day 7)	Not detected after 24 h	-1.50 * (day 7)	-1.49 ** (day 7)
	High[C]	Dirty	-0.75 * (day 7)	-0.81 ** (day 7)	-1.17 * (day 7)	-0.35 * (day 7)	-0.27 (day 7)
		Clean	+0.05 (day 2)	-2.01 ** (day 7)	-5.28 ** (day 5)	+0.61 ** (day 7)	-0.09 (day 7)
E. coli O157	Low	Dirty	-1.29 * (day 7)	+0.22 * (day 7)	-1.36 ** (day 5)	+0.46 * (day 7)	-1.16 ** (day 7)
		Clean	Not detected after 24 h	Not detected after 24 h	-6.48 * (day 4)	-4.52 ** (day 7)	-1.46 ** (day 7)
	High	Dirty	-1.44 * (day 7)	-0.80 ** (day 7)	-0.02 (day5)	-0.44 * (day7)	-0.84 * (day7)
		Clean	-3.28 * (day 5)	-0.21 (day 7)	-4.67 ** (day 3)	+1.06 * (day 7)	-0.02 (day 7)
Campylobacter jejuni	Low	Dirty	-0.38 * (day 7)	-3.28 ** (day 7)	-2.34 * (day 5)	-0.96 * (day 7)	+2.25 * (day 7)
		Clean	Not detected after 24 h	Not detected after 24 h	Not detected after 24 h	Not detected after 24 h	-1.49 * (day 7)
	High	Dirty	-2.46 ** (day 6)	-2.12 ** (day 3)	-3.59 * (day 4)	-2.83 * (day 4)	-1.54 * (day 6)
		Clean	Not detected after 24 h	Not detected after 24 h	Not detected after 24 h	-2.49 * (day 1)	-0.38 (day 7)

[A] Change = final count minus initial count;
[B] Humidity of 62%;
[C] Humidity of 95%;
[D] Inoculated with pathogens suspended in faeces;
[E] Inoculated with pathogens suspended in broth;
[F] Time when the change recorded
* Difference significant at P<0.05;
** Difference significant at P<0.001