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The epidemiology of salmonella in calves: the role of markets and vehicles

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SUMMARY

Environmental contamination has been shown to be an important aspect of the epidemiology of salmonellosis in calves. Markets and transport vehicles are important links in the calf marketing chain and these were investigated to determine the level of salmonella contamination.

Salmonellas were isolated from 7 of the 14 markets surveyed, with 31 of 838 samples (3·7%) being positive. Nine different salmonella serotypes, of which the commonest was *Salmonella typhimurium*, were isolated. Four different phage types of *S. typhimurium* were detected, the commonest being DT204C.

Salmonellas were isolated from 22 of the 107 vehicles (20·6%) examined before washing and from 4 of the 62 vehicles (6·5%) examined after cleaning. Twelve different salmonella serotypes were isolated, of which the most frequent was *S. typhimurium*. The commonest of the six different *S. typhimurium* phage types was DT204C.

These results indicate that improved cleaning and disinfection routines both for vehicles and markets are necessary to control salmonellosis in calves.

INTRODUCTION

Salmonella typhimurium infection is an important cause of mortality in market purchased calves [1]. The spread and persistence of salmonellas on calf rearing units and on dealers' premises has been the subject of previous studies [2–4]. Likewise the spread of *S. typhimurium* from markets by dealers has been investigated by the use of plasmid profile to 'fingerprint' the organism [5]. All of these studies showed the importance of salmonella contamination in the environment in the perpetuation of the disease. We are, however, unaware of any published reports of similar investigations in calf markets and vehicles used for calf transport, yet these are the first link in the calf marketing chain.

As pointed out previously [4] it is unlikely that examination of calves in the market will yield much information because of the small numbers of calves likely to be excreting salmonella. Consequently environmental monitoring for salmonella is likely to provide more useful information. This paper describes the level of salmonella contamination in calf markets and transport vehicles.

MATERIALS AND METHODS

Markets

Fourteen markets were sampled once a week after the calf sales for a period of 6 weeks. Details of the different markets are given in Table 1. On each visit ten samples were collected from an equal number of sites which comprised the floors and walls of the holding pens, metal fixtures and the drain. However, because the design of the markets differed there was variation between the number of actual sites sampled. If salmonellas were isolated that site would be re-sampled on the following two visits. It was not possible to sample markets after cleaning because of the presence of other livestock and vehicles.

Vehicles

Three samples, usually the floor, either the front or sidewall and internal fittings were collected from 169 vehicles used for the transport of calves. Of these vehicles, 107 were sampled before cleaning and disinfection, and 62 were resampled after cleaning.

Sampling procedures

Walls (markets and vehicles)

The swab consisted of a fist-sized piece of absorbent cotton-wool which had been autoclaved in labelled jars containing 250 ml buffered peptone water. Using disposable gloves the cotton wool was squeezed out and then wiped vigorously over a wall area of approximately 36 sq. ft, starting from floor level and working upwards to include corners and projections as appropriate. The soiled swab was replaced in the jar and the gloves discarded.

In the case of market fixtures and internal fittings of lorries swabbing commenced at the bottom of an upright and continued upwards, horizontal rails were sampled for 3 ft each side of the upright.

Floors

Fist-sized pieces of absorbent cotton-wool which had been previously wrapped and sterilized were moistened in jars containing 250 ml selenite broth. The swab was rubbed vigorously over an area of approximately 20 sq. ft after drawing back bedding, if present, and then placed in the jar containing selenite broth.

Drains

A Moore's swab was suspended from the drain grating and collected weekly when the swab was placed in a jar containing 100 ml selenite broth.

Bacteriological procedures

Swabs from walls and fittings

The buffered peptone water containing the swab was incubated for 18 h at 37 °C and 1 ml was then transferred to 100 ml Rappaport's broth (Oxoid CM66a). After incubation at 42·5 °C for 48 h sub-cultures were made onto Brilliant Green agar (Oxoid CM32a) which was incubated at 37 °C for 18 h and then examined for the presence of salmonellas.

Table 1. *Isolation and salmonellas from calf markets*

Market	No. of markets/week	No. of markets at which calves sold	Weekly throughput of calves	No. of sites from which salmonella isolated/No. of samples	Salmonella serotypes (phage type) isolated
A	1	1	1–200	1/60	*S. derby*
B	1	1	300	0/60	
C	2	1	7–1000	1/54	*S. give*
D	2	1	850	6/60	*S. typhimurium* (110, 193 and 204C) *S. mbandaka*
E	1	1	260	7/60	*S. typhimurium* (110) *S. enteritidis* (2), *S. stanley*
F	3	1	160	1/60	*S. newport*
G	2	1	850	7/66	*S. anatum*, *S. muenchen* *S. typhimurium* (49, 204C)
H	3	1	700	0/60	
I	2	2	700	8/58	*S. give* *S. typhimurium* (49, 204C)
J	2	1	200	0/60	
K	1	1	50/100	0/60	
L	2	1	150/200	0/60	
M	1	1	150	0/60	
N	1	1	150	0/60	

Swabs from floors and drains

The selenite broths containing the swabs were incubated for 18 h at 37 °C and subcultured onto Brilliant Green agar plates. After incubation at 37 °C for 18 h the plates were examined for the presence of salmonellas.

RESULTS

Salmonella isolations from markets

Salmonellas were isolated from 7 of the 14 markets investigated; with 31 of the 838 samples (3·7 %) being positive. The number of isolations varied from 1 in the case of markets A, C and F to 7 or 8 in the case of markets E, G and I (Table 1). Most isolations were made from the floor samples. Nine different salmonella serotypes, of which the commonest was *S. typhimurium*, were isolated (Table 1). Four different phage types of *S. typhimurium* were detected, the commonest being DT204C.

There did not appear to be an association between the size of the market and the level of salmonella contamination. Thus 7 of 60 samples from market E and 8 of 58 samples from market I yielded salmonellas. The weekly throughput of calves for these markets was 260 and 700 calves respectively.

Table 2. *Isolation and salmonellas from vehicles used for calf transport*

	No. of salmonella isolations	No. of samples	Salmonella serotype. Phage type of Stm* (no. of isolations)
Before washing			
Vehicles	22	107	
Floor	15	107	Stm 108 (1), 18 (1), 9 (1), 193 (3), 204 (1) and 204C (5); *S. dublin* (4); *S. newport* (4); *S. give* (1); *S. goldcoast* (1); *S. thompson* (1); *S. indiana* (2); *S. agona* (1); *S. livingstone* (1); *S. mbandaka* (5); *S. coeln* (1)
Walls	9	182	
Fittings	9	82	
After washing			
Vehicles	4	62	
Floor	2	62	*S. anatum* (2); *S. dublin* (3); Stm 204C (1)
Walls	3	124	
Fittings	1	62	

* Stm, *S. typhimurium*.

Salmonella isolations from vehicles

Salmonellas were isolated from 22 of the 107 vehicles (20·6%) examined before washing and from 4 of the 62 vehicles (6·5%) examined after cleaning (Table 2). Twelve different salmonella serotypes were isolated, of which the most frequent were *S. typhimurium*, *S. dublin* and *S. mbandaka*. The commonest of the six different *S. typhimurium* phage types was DT204C. Two different serotypes were isolated from two of the lorries. Most isolations were made from the floor samples and in the dirty lorries 10% of the fittings were found to be contaminated.

DISCUSSION

The wide range of salmonella serotypes isolated from markets was unexpected and included many which are not normally associated with disease in calves [6]. Most isolations were made from the floors of the calf pens and this may be attributable to contaminated material being 'trodden through' by the animals from either the vehicles used for transport or their recent accommodation. The high level of vehicle contamination found during this survey provides support for this suggestion. In addition such vehicles are frequently used to transport other species of livestock which may be infected with many different salmonella serotypes. Other possible explanations would include run off from pens used for other species of farm animals and possibly wild birds. Although the numbers of salmonellas are likely to be small they represent a potential source of infection for calves, and also for other animals passing through. Transport is stressful for young calves and may affect several functions including disease resistance [7]. Thus calves may be infected during transport and disseminate infection to other calves

either at the rearing farm or in other markets. It has been found that a group of pigs infected with salmonella during transit rapidly transmitted the organism to other pigs in the abattoir lairage [8]. Latent salmonella infection in calves has also been shown to be activated and spread to other calves during transport [9].

The survey has shown that many vehicles and markets are contaminated with salmonella and that *S. typhimurium* DT204C, the commonest salmonella from calves was a frequent isolation. Six per cent of vehicles were still contaminated after washing, and while improvements to cleaning and disinfection routines both for vehicles and markets are desirable, attention should also be paid to vehicle design.

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