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Chemical closet treatment of typhoid carrier faeces

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SUMMARY

An investigation to test the efficiency of chemical closets in treating excreta from typhoid carriers is described. The use of these closets kept a stream, which had in the past frequently contained *Salmonella typhi*, typhoid free for 24 months. Selenite broth as made in this laboratory, containing a final concentration of 0·8% sodium hydrogen selenite when inoculated with the water sample, was significantly better than commercial selenite brilliant green enrichment broth for the recovery of *S. typhi*.

INTRODUCTION

Disposal of faeces from chronic typhoid carriers in a mental hospital of 1850 beds near Cardiff had posed a problem for many years. This hospital had been previously investigated by Gell, Hobbs & Allison (1945). Disinfection of bedpans with lysol (Harvey, 1957) and sewage disinfection with iodophors had given very unsatisfactory results. In 1963, 'Destrol' chemical closets were installed in a ward toilet block for the exclusive use of the typhoid carriers. 'Destrol' fluid appears from analysis to be a mixture of chlorxylenol, an aniline dye indicator and a zinc compound. All three constituents are emulsified in pine oil.

In this communication we have used the disappearance of typhoid bacilli from brook water sampled below the entry of hospital effluent as an indication of the effectiveness of the 'Destrol' closets. A comparison is also made of S.B.G. enrichment broth used in isolation procedures with our own quadruple strength selenite F broth (Harvey & Price, 1964).

MATERIALS AND METHODS

One litre samples were collected at a convenient point (Point A: Gell *et al.* 1945), and brought straight to the laboratory. The stream was swift running and there was no evidence of pollution on the banks: samples were not obviously contaminated with sewage to the naked eye. The hospital was not informed about the time of the visits.

Enrichment media

Enrichment culture of the stream was essential for the demonstration of *Salmonella typhi*. Previous attempts at isolation by direct plating had been

unsuccessful. Both diluted and undiluted water had been examined using Wilson and Blair's bismuth sulphite agar (de Loureiro, 1942).

Selenite F broths. In 1965 and 1966, the 1000 ml. sample was equally divided between 500 ml. of double strength and 500 ml. of quadruple strength selenite F broth. The quadruple strength enrichment medium gave a final concentration of 0·8 % sodium hydrogen selenite when the water sample was added.

The 0·8 % selenite medium developed from a study of Leifson's (1936) paper, which implied that *S. typhi* might be more resistant to selenite than *S. paratyphi B*. As *S. paratyphi B* was occasionally present in the stream during our early studies and had created cultural difficulties to other workers (Gell *et al.* 1945), the 0·8 % concentration seemed necessary for accurate monitoring of the water. This enrichment broth also aided recovery of *S. typhi* in the presence of other salmonella serotypes and effectively inhibited *B. effluviei* (Wilson, 1928). Presence of competing organisms can be a major problem in investigating sewage, particularly crude effluent. *B. effluviei* is colonially similar to *S. typhi* on Wilson and Blair's medium and can easily confuse attempts to trace typhoid carriers by sewage examination (Harvey, 1957). Concentrations of selenite above 0·8 %, as suggested by Leifson (1936) for sewage examination have not proved valuable in our hands. Callaghan & Brodie (1968) have recently reported favourably on a fluid medium containing 0·8 % sodium hydrogen selenite + streptomycin sulphate.

Selenite brilliant green broth. Selenite brilliant green broth, with and without sulphapyridine, has been suggested for enrichment culture of *S. typhi* by other authors (Pilsworth, 1960; Livingstone, 1965). We decided to compare the two enrichment media using 500 ml. quantities of water sample for each medium. The S.B.G enrichment broth in our investigation was used in accordance with Livingstone's (1965) instructions.

Incubation temperature

Elevated temperature enrichment (incubation at temperatures above 37° C.) is not suitable for isolating *S. typhi* (Harvey & Thomson, 1953), although there are reports where this has been used for plate incubation (Wilson, 1928; Livingstone, 1965). The usual temperature of 37° C was, therefore, used with an incubation time of 24 hr. This timing had been found better than 18 hr. in a previous study (Harvey, 1965). Subcultures were made to de Loureiro's (1942) modification of Wilson and Blair's bismuth sulphite agar. This formula gives very consistent results. It is used unripened. Plates were incubated at 37° C and examined at 24 and 48 hr. Suspicious colonies were picked for further examination.

RESULTS

In 1965, 3/30 samples of brook water contained *S. typhi*. In 1966, however, 21/51 samples were positive for *S. typhi* and we, therefore, believed that the closets were not functioning properly. On inquiry, we learned that, for a period, patients had been responsible for using the closet agitators. This may explain sub-optimal functioning.

Table 1. *Isolation of* Salmonella typhi *from Morfa Brook*

Year	Positive samples	Total samples	Number of regular excreters in hospital
1967	5	42	4
1968	3	46	3
1969	4	49	2
1970	0	49	2
1971	0	14	1

Faeces samples from carriers examined monthly. No *S. typhi* found in stream between 26 March 1969 and 5 April 1971.

Table 2. *Isolation of salmonellas* (*excluding* Salmonella typhi) *from Morfa Brook*

Year	Positive samples	Total samples	Serotypes
1967	0	42	—
1968	4	46	*S. bredeney*
1969	5	49	*S. eimsbuettel* *S. panama* *S. senftenberg* *S. dublin*
1970	6	49	*S. panama* *S. dublin* *S. indiana* *S. eimsbuettel* *S. kiambu* *S. infantis*
1971	3	14	*S. infantis* *S. panama*

Monitoring of the stream continued from 1967, when nursing staff became responsible for supervision of closet use, and has continued without intermission. The results are recorded in Table 1. Other salmonella serotypes were also isolated and are shown in Table 2. The comparison of efficiency of the two enrichment media is given in Tables 3 and 4.

In this investigation, *B. effluviei* was only found in five samples. It was isolated once from 0·8 % selenite broth and five times from S.B.G. enrichment. This supports earlier unpublished observations that 0·8 % selenite enrichment inhibited *B. effluviei*.

DISCUSSION

The Morfa Brook was well known to the laboratory (Gell *et al.* 1945; Harvey, 1957). It was a natural water from which, in the remote past, we had little difficulty in isolating *S. typhi*, phage-type C_1. When, in 1965, we began a regular sampling programme to ascertain the effect of 'Destrol' closets, 3/30 samples contained *S. typhi*. This seemed a reasonable contamination rate compared with

Table 3. *Isolation of* Salmonella typhi *from* 200 *water samples*

Quadruple strength selenite broth	S.B.G. broth	No. of positive samples
+	+	1
+	−	10
−	+	1
−	−	188

The statistical test appropriate is Fisher's exact test $P = 0{\cdot}005$ *significant.*
The quadruple strength selenite broth is significantly superior to S.B.G. enrichment for the isolation of *S. typhi* under these study conditions.

Table 4. *Isolation of salmonellas other than* S. typhi *from* 200 *water samples*

Quadruple strength selenite broth	S.B.G. broth	No. of positive samples
+	+	6
+	−	13
−	+	5
−	−	176

The statistical test appropriate is McNemar's test $\chi^2 = 2{\cdot}72$, $P = 0{\cdot}10$, not significant.
The 200 samples in Tables 3 and 4 were identical and consecutive. This formal media comparison ceased on 5 April 1971.

previous experience. The following year, however, when *S. typhi* was isolated on 21 occasions from 51 samples, we notified the relevant authorities. We were informed of the change in agitation routine and were told that nursing staff would again become responsible for closet supervision. A long-term survey of the qualitative typhoid contamination of the brook was, therefore, planned. The survey covered a period of almost 5 years (Table 1). Twelve isolations of *S. typhi* have been made in that time out of 200 samples. All isolations belonged to phage-type C_1.

The most important information derived from Table 1, was our failure to find *S. typhi* in the brook over the last 24 months of the survey despite the presence in the hospital of chronic typhoid carriers regularly excreting the organism in their faeces. Before the end of the investigation, several of the original carriers had died and this obviously diminished the quantity of faeces requiring treatment.

It would seem that in 1970 and 1971, when agitation was properly performed, 'Destrol' closets successfully rid the hospital effluent of *S. typhi*.

In our hands, quadruple strength selenite F broth proved a more satisfactory enrichment medium for isolation of the typhoid bacillus than S.B.G. enrichment broth. This did not surprise us as *S. typhi* is brilliant green sensitive (Harvey, 1956). The quadruple strength selenite F broth, therefore, has become part of our routine procedure when searching for *S. typhi*. By its use we isolated typhoid bacilli from the River Ogmore near the entry of the Morfa Brook and two miles downstream from the hospital effluent discharge (Harvey, 1957). The laboratory-prepared medium was significantly superior, in this study, to the commercial medium. There was no significant difference between the media when salmonellas other than *S. typhi* were considered.

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