THE BACTERIOLOGY OF THE BANTU FOOD-HANDLER: ENTEROBACTERIACEAE

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Recent surveys on salmonelloses and shigelloses in South Africa[1,2] show that our knowledge of the subjects is very incomplete. For instance, the reservoirs of infections have received little attention,[2] but it is often thought that the apparently healthy Bantu food-handler may be a carrier and thus spread the diseases. This is exemplified in the prophylactic measures adopted for the prevention of typhoid fever. For many years it has been the practice to test prospective or employed food-handlers for circulating Vi-agglutinins and to examine their excreta for the presence of *Salmonella typhi*. The doubtful value of indiscriminate Vi-testing has been dealt with in another communication.[12] Cultural examination is open to many pitfalls but, to the best of our knowledge, nothing has been published in South Africa about the possible errors involved or, as regards food-handlers, the value of the results obtained. It would be of interest to know the frequency of salmonellae and of shigellae in faeces and urine, as well as the smallest number of specimens that must be examined before the subject is declared free of these organisms. Furthermore, in case of positive findings, the type of organism causing the infection must be stated, and attempts should be made to determine whether the people concerned are chronic carriers or merely short-time infected individuals with subclinical symptoms. As regards chronic carriers, it is worth considering whether it is necessary to adopt the same prophylactic precautions irrespective of the type of organism recovered; although it is essential to bar a typhoid carrier from the food trade it does not follow that the same applies if he is a carrier of, say, *S. johannesburg*.

Despite the many unknown factors involved, the present system of prophylactic investigation is often regarded as satisfactory. Some workers doubt its value but adopt it on the plea that no better method is available. It appears, therefore, that a careful examination of the problem is necessary in order to determine whether the method is bacteriologically and economically sound.

Material and Methods. The information was obtained from the 1958 files of the South African Institute for Medical Research, which dealt with the bacteriological investigation of faeces and urine from prospective or employed Bantu food-handlers attached to the mining industry in the Transvaal. The conditions under which the specimens were obtained, and particularly whether purgatives were used,[8] are unknown. The excreta, usually submitted without transport media, were examined for salmonellae and shigellae although in the majority of cases only *S. typhi* investigation was requested. The specimens were planted on SS- and McConkey plates, and a selenite enrichment medium. The biochemical characteristics of the isolated colonies were examined in composite media and the cultures conforming to the pattern of salmonellae or shigellae were investigated serologically. The salmonellae were typed but the shigellae were classified only by their major antigen.

RESULTS

In 1958, 2,778 specimens of excreta were examined from 1,565 Bantu food-handlers (Table I). It appears to be common practice to search for enteric pathogens in both urine and faeces, but in almost a quarter of the cases only one specimen

TABLE I. ORIGIN OF SPECIMENS

	Food-handlers		*Specimens*	
	Number	*Percentage*	*Faeces*	*Urine*
One specimen of faeces only ..	244	15·6	244	—
One specimen of urine only ..	137	8·8	—	137
One specimen of faeces and one of urine	1,166	74·5	1,166	1,166
Faeces and urine, 3 or more specimens	18	1·2	40	25
Total	1,565		1,450	1,328

was submitted, and then faeces (15·6%) more often than urine (8·8%). The choice of specimens was a peculiarity of the individual mines, some always submitting faeces and urine, others faeces only or urine only. On an average 1·8 specimens were received per individual. Among these was an occasional follow-up specimen received from those found to harbour pathogenic organisms.

Table II shows that from 75 (4·8%) of the individuals either salmonellae (67 cases) or shigellae (9 cases) were

TABLE II. RECOVERY OF SALMONELLA AND SHIGELLA ORGANISMS

	Food-handlers		*Specimens of Faeces*		*Specimens of Urine*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Salmonellae ..	67	4·3	68	4·7	0	—
Shigellae ..	9	0·6	8	0·6	1	0·08
Total ..	75	4·8	76	5·2	1	0·08

isolated. One of the food-handlers was infected with *S. albuquerque* and *S. montevideo* and another with *S. albuquerque* and *Sh. sonnei*. Of the faecal specimens 76 (5·2%) were infected, as against a negligible percentage of the urine samples. The recovered salmonellae were of 25 different types. Their distribution according to the Kauffmann-White scheme[3] is set out in Table III. In order of frequency, *S.*

TABLE III. THE SALMONELLA TYPES GROUPED ACCORDING TO THE KAUFFMANN-WHITE SCHEME[3]

Groups and Types	*No.*		*Groups and Types*	*No.*	
Group B			*Group E1*		
S. typhi murium	2		S. anatum	9	
S. paratyphi B	2		S. london	2	
S. saint-paul	1		S. newlands	1	
S. abortus bovis	7			12	(17·7%)
S. wagenia	2		*Group F*		
S. chester	5		S. aberdeen	2	(2·9%)
S. san diego	1		*Group G*		
	20	(29·4%)	S. poona	1	(1·5%)
Group C1			*Group H*		
S. montevideo	8		S. albuquerque	2	(2·9%)
S. thompson	1		*Group N*		
Group C2			S. london	1	(1·5%)
S. newport	4		*Group P*		
S. labadi	1		S. adelaide	4	(5·9%)
Group C3			*Group S*		
S. kentucky	2		S. johannesburg	5	
	16	(23·5%)	S. duval	1	
Group D1				6	(8·8%)
S. typhi	1		*Group T*		
S. dublin	2		S. waycross	1	(1·5%)
	3	(4·4%)			

anatum, *S. montevideo*, *S. abortus bovis*, *S. chester* and *S. johannesburg* were the commonest, and, as an outstanding feature, *S. typhi* was only isolated once. 75% of the strains belonged to groups A-E, with groups B and C 1-3 accounting for 52·9% of the types. Members of groups P and S were fairly common.

Of the 9 shigella strains isolated, 3 were identified as *Sh. schmitzii*, 1 as *Sh. sonnei*, 3 as *Sh. flexneri*, 1 as *Sh. newcastle* and 1 as *Sh. boydii*.

As far as can be seen from the records, 11 of the infected food-handlers were followed up with one, and only 4 with several bacteriological investigations, the results of which were all negative.

The flow of specimens was comparatively constant throughout the year except in July, when the number of requested investigations was doubled. The number of recovered salmonella strains showed little seasonal variation (Table IV).

TABLE IV. SEASONAL DISTRIBUTION OF INFECTED INDIVIDUALS

Month	*Salmonella*	*Shigella*	*Month*	*Salmonella*	*Shigella*
Jan. ..	8	1	July ..	4	—
Feb. ..	6	—	Aug. ..	14	—
Mar. ..	6	—	Sep. ..	5	—
Apr. ..	3	2	Oct. ..	9	—
May ..	4	—	Nov. ..	2	2
June ..	4	2	Dec. ..	2	2
			Total ..	67	9

It is noteworthy that the incidence did not increase during the summer months, November to March. The relatively high number of recoveries in August may reflect the delay in sero-typing of the strains isolated from the many specimens received during July. It appears that shigella types may be expected at all times of the year.

DISCUSSION

The constant request for investigation for the presence of *S. typhi* shows that the major problem confronting the health authorities is to establish whether a prospective food-handler is a carrier, and particularly an excreter of this organism. Owing to the relative importance of other salmonelloses[4,6] the examination was extended to include all salmonellae and shigellae.

It is generally agreed that carriers excrete salmonellae far more often in faeces than in urine.[4-8] Consequently the bacteriological examination of urine only, as is requested by some mines, is of little value; investigation of faeces only would have been a better choice. Since no reliance can be placed on a single negative finding on cultural examination of faeces or urine, whatever method is used,[5,11] and because the excretion of salmonellae in carriers and convalescents may be intermittent,[5,8,9] many specimens may have to be examined before a positive result is obtained. The submission of additional specimens from individuals with one negative finding was so rare that for all practical purposes it was non-existent. The food-handler records do not indicate that those yielding a growth of salmonellae or shigellae were followed up bacteriologically. It is possible that these patients were transferred to isolation wards for continued observation and thus escaped these files. Nevertheless, the conclusion to be drawn is that the present system of bacteriological examination of food-handlers is superficial and inadequate in establishing freedom from enteric infections and, in fact, merely serves as a public tranquillizer. It may be argued that the proper bacteriological control of the food-handlers is impracticable; if this be true, it would possibly be more rewarding to concentrate the efforts on improving the sanitary conditions[10,11] and the education in hygiene of the personnel.[11]

Despite the limited investigations, it was found that 4·3% of the individuals and 4·7% of the specimens of faeces were infected with salmonellae. Thus, the proportion of recoveries

from faecal specimens is of the same order as that obtained during 1957 in our routine laboratory (4%).[2] This is in contrast to expectation, since a considerable proportion of the routine specimens originated from patients with diarrhoea The possibility exists that the epidemiological environments were different, partly because the specimens originated from geographically different areas, and partly because the two surveys were done in consecutive years.

The group-distribution of salmonella types agrees very accurately with our previous findings in South Africa,[2] but the type-distribution is different. The commonest types in that survey were *S. adelaide*, *S. typhi murium*, *S. labadi*, *S. london* and *S. montevideo*. Except for *S. montevideo*, entirely different strains occupy the first five places in this survey (Table III), and it is striking that the notorious pathogen *S. typhi murium* was rare among the food-handlers. This may also be explained in terms of different epidemiological environments. But it is interesting to speculate on the possibility that the differences may be attributable to inequality in pathogenicity of the strains, or alternatively to variations in clinical susceptibility between the patients with diarrhoeal disorders and the apparently healthy food-handlers who harbour salmonellae.

This raises the question whether the food-handlers from whom salmonellae other than *S. typhi*, or shigellae, were isolated were chronic carriers, or individuals infected for a short period of time but with subclinical symptoms. If all infected persons were chronic carriers, the carrier rate would be at least 4·8% (Table II), but it seems more reasonable to assume that some of them merely harboured the organisms temporarily. This is supported by the failure of re-isolation of enteric pathogens in the 11 subjects from whom we received more than one specimen. On the other hand, if there were a substantial number of subclinical infections with salmonellae in the food-handlers, a seasonal variation in incidence corresponding to that of clinical salmonelloses[2] might be expected; but that was not the case. From the data available it would be unwise to dogmatize on the significance of salmonellae in the excreta of apparently healthy food-handlers.

As regards shigellae, comparatively few strains were isolated; this may possibly be due to the lapse in time between the voiding of the excreta and their arrival in the laboratory. But it may also reflect a low incidence of shigelloses among the food-handlers.

SUMMARY

In 1958, 2,778 specimens of excreta were examined from 1,565 Bantu who were prospective or employed food-handlers of 19 gold mines in the Transvaal.

No uniformity existed in the selection of specimens, or in the number submitted from the individual food-handler. Generally, one specimen of faeces and one of urine were supplied, but in a quarter of the cases only a single specimen of faeces or urine was provided, on which his suitability as a food-handler had to be assessed. Duplicate specimens were rare. It appears, therefore, that the health authorities on the mines regard a single negative examination of faeces and urine as indicative of the absence of salmonellosis and shigellosis. In a quarter of the cases they are satisfied with even less.

Despite these limited investigations, 75 individuals (4·8%) were found to be infected with salmonella or shigella organisms, all but one being of faecal origin. Accordingly, the submission of urine specimens is of little value. Salmonellae occurred 8 times more frequently than shigellae and comprised 25 different sero-types. *S. typhi* was isolated only once. The shigella strains were of 5 different sero-types.

No seasonal prevalence of infection was observed in this material.

The findings are discussed and the opinion expressed that the present system of bacteriological control of prospective or employed Bantu food-handlers on the mines is inadequate in establishing freedom from *S. typhi* infection. Whether the food-handlers infected with enteric pathogens were chronic carriers or short-time infected individuals cannot be established from the data presented.

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