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Colony incompatibility studies among New Zealand and Australian isolates of *Salmonella typhimurium* phage type 179

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SUMMARY

Recent New Zealand and Australian isolates of *Salmonella typhimurium* phage type 179 were studied for relatedness by colony incompatibility. This established that all but one strain of the New Zealand groups probably formed a clone despite carrying a variety of plasmids. The Australian strains showed a far greater diversity. This study demonstrates the epidemiological usefulness of the colony incompatibility reactions.

INTRODUCTION

Colony incompatibility is considered as the reaction, which occurs when swarms of organisms of different motile strains meet. It is probably a general phenomenon, of which the *Dienes* phenomenon of *Proteus* strains is only a special case because of the increased motility of *Proteus* organisms (Bettelheim & Carlile, 1976).

There have been a number of suggestions as to the mechanisms of this phenomenon, however, none have provided a full explanation. By demonstrating that the phenomenon between two strains of *S. typhimurium* phage type 179 occurred in identical form in whichever H antigen phase the organisms were (Bettelheim, 1978*a*) it was established that the H antigen was not involved. Following the demonstration that bacteriocins play a crucial role in many, but not all examples of the *Dienes* phenomenon (Senior, 1977) the role of bacteriocins in colony incompatibility among strains of *Salmonella* was investigated (Bettelheim 1978*b*), but bacteriocins could not be shown to be present. It was suggested that the incompatibility reaction may be due to the presence of substances released by some strains, eliciting a negative chemotactic response in others.

Whatever the basis of the reaction, it may be possible to use it for epidemiological purposes. Phage type 179 of *S. typhimurium* is relatively rare in New Zealand having been first found in 1977 (S. M. Harding, personal communication). However, this phage type is quite common in Australia (J. Taplin, personal communication). It was therefore decided to investigate the possible use of colony incompatibility to differentiate between these strains.

Table 1. *List of strains used in this study and their sources*

Source		Strains
New Zealand		
Human	Auckland	456, 853, 435, 850, 666 851, 1163, 600
	Christchurch	2194
	Rotorua	2932
	Ashburton	512
Australia		
Human	New South Wales	201030
	South Australia	202095
	Tasmania	202099
	Victoria	202525
	Queensland	202102
	Northern Territory	203952
	Western Australia	201082
Chicken	Victoria	200316
	Western Australia	201076
Chicken litter	New South Wales	204409

Table 2. *Incompatibility reactions between New Zealand and Australian strains of* S. typhimurium *phage type* 179 *and the type strain* (T179)

Strains	T179	456	512	853	435	2194	850	666	851	1163	600	2932	201030	201076	202095	202099	204409	202525	200316	202102	203952	201082
T179	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	4	4	3
456	3	0	0	0	0	0	0	0	0	1	1	2	3	3	3	4	0	0	0	3	4	3
512	3	0	0	0	0	0	0	0	0	1	1	3	2	3	3	4	1	1	0	3	3	3
853	3	0	0	0	0	0	0	0	0	1	1	3	1	2	3	3	1	2	0	3	3	3
435	3	0	0	0	0	0	0	0	0	1	1	3	3	2	3	2	1	2	0	3	3	3
2194	3	0	0	0	0	0	0	0	0	1	1	3	3	3	4	3	1	2	3	3	3	3
850	3	0	0	0	0	0	0	0	0	1	1	3	2	2	4	4	1	0	0	3	4	3
666	3	0	0	0	0	0	0	0	1	1	1	3	3	3	3	2	2	2	0	4	3	3
851	3	0	0	0	0	0	0	1	0	1	2	3	3	2	3	2	2	3	2	3	3	3
1163	3	1	1	1	1	1	1	1	1	0	1	3	2	3	3	3	1	1	2	3	3	3
600	3	1	1	1	1	1	1	1	2	1	0	3	2	2	2	0	2	2	2	2	3	1
2932	3	2	3	3	3	3	3	3	3	3	3	0	1	2	1	0	3	4	2	1	4	1
201030	3	3	2	1	3	3	2	3	3	2	2	1	0	0	1	1	3	2	3	3	2	2
201076	3	3	3	2	2	3	2	3	2	3	2	2	0	0	2	1	3	3	3	1	1	3
202095	3	3	3	3	3	4	4	3	3	3	2	1	1	2	0	0	3	2	3	2	1	3
202099	3	4	4	3	2	3	4	2	2	3	0	0	1	1	0	0	3	3	3	1	3	3
204409	3	0	1	1	1	1	1	2	2	1	2	3	3	3	3	3	0	0	0	2	3	3
202525	4	0	1	2	2	2	0	2	3	1	2	4	2	3	2	3	0	0	1	2	3	3
200316	3	0	0	0	0	3	0	0	2	2	2	2	3	3	3	3	0	1	0	3	3	3
202102	4	3	3	3	3	3	3	4	3	3	2	1	3	1	2	1	2	2	3	0	3	3
203952	4	4	3	3	3	3	4	3	3	3	3	4	2	1	1	3	3	3	3	3	0	3
201082	3	3	3	3	3	3	3	3	3	3	1	1	2	3	3	3	3	3	3	3	3	0

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MATERIALS AND METHODS

Bacterial strains

The type strain of phage type 179 as well as the New Zealand isolates, which had been sent to the National Health Institute, Wellington, for identification were obtained from S. M. Harding. They have been extensively investigated for the presence of plasmids, antibiotic resistance and other properties (Anderson, 1980) and are listed in Table 1.

The Australian strains were obtained from J. Taplin, as a collection of random isolates from many parts of Australia sent to the Microbiological Diagnostic Unit, University of Melbourne, for identification. They are also listed in Table 1.

Test of compatibility

The same methods described previously (Bettelheim, 1978*a*, *b*) were used. The incompatibility zones were also scored as before (Bettelheim, 1978*a*, *b*) with complete merging of zones or full compatibility being scored as zero and total incompatibility with a zone of over 10 mm being scored as "4".

RESULTS

The results of testing all New Zealand and Australian strains of phage type 179 listed in Table 1 as well as the type strain are presented in Table 2. All tests have been performed in triplicate and where slight differences in scoring occurred due to the subjective nature of the scoring the mean score was taken.

Those groups of strains considered compatible are placed into the arbitrary groups listed in Table 3.

DISCUSSION

This study demonstrates that compatibility reactions can be used to distinguish between strains of *S. typhimurium* of the same phage type. The type strain was shown to be incompatible with the strains from both countries and thus to form a separate unit.

Despite the variety of antibiotic resistances and plasmids demonstrated in the New Zealand isolates (Anderson, 1980) all but one of these strains appeared to form a compatible group suggesting that they may comprise a clone (Table 3).

The ten Australian strains formed three compatible groups of three or two strains as well as three strains which were incompatible with all other strains (Table 3).

The interactions between the Australian and New Zealand strains only partly confirmed these incompatibility groups, suggesting that many more factors as yet not fully understood may play a role in this phenomenon. A recent study on strains of *Escherichia coli* (Bettelheim, 1980) has suggested that these interactions may be involved in aspects of pathogenicity, it may therefore be important in future studies on these organisms to test for incompatibility reactions. At present the only way these can be successfully studied is by testing all strains against each

Table 3. *Groups of strains considered compatible according to the results in Table 2*

Group	Strains
A	T179
B	456, 512, 853, 435, 2194, 850, 666, 851, 1163, 600
C	2932
D	201030, 201076
E	202095, 202099
F	204409, 202525, 200316
G	202102
H	203952
I	201082

other as was done in this study. The establishment of a set of indicator strains for each phage type of *S. typhimurium* would remove this necessity. This might create a set of epidemiologically useful subdivisions of each phage type.

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