

Inhibition of *Salmonella* Cultures by Streptomycin.*

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Streptomycin is known to be active against various gram-negative bacteria, but little is known of its action on *Salmonella*. The present paper is a report of the *in vitro* inhibition of 412 *Salmonella* cultures by the agent. The cultures employed in the work included 154 distinct serological types which comprised all the presently recognized forms in the genus. Only one or two representatives of the majority of the types were studied since most of them occur very rarely. A number of the types which occur more frequently and which are better known were represented by a larger number of cultures.

The tests were performed by streaking tryptose agar plates which contained varying amounts of streptomycin with a 2 mm loopful of a saline suspension which contained approximately 100 million cells per ml. Streptomycin was added in amounts of 1, 2, 4, 8, 16, 32, and 64 units per ml of agar. Two samples of streptomycin which contained respectively 80 and 120 units per mg were used and similar results were obtained with both samples.† Streptomycin was added to the melted and cooled agar which was poured into plates and streaked immediately after hardening with freshly prepared bacterial suspensions. The plates were incubated 24 hours at 37°C. The smallest amount of streptomycin which suppressed all visible growth of the bacteria was recorded as the inhibitive concentration.

It was not found practical to space the dilutions of streptomycin more closely than the serial dilutions mentioned above since there was a gradual inhibition of growth as the

amount of streptomycin increased. In some cultures a few resistant colonies developed on plates which contained the higher concentrations. In others complete inhibition was preceded by the occurrence of pin-point growth in one or two dilutions. Many of the tests were repeated several times and comparable results were obtained. The point of complete inhibition sometimes varied one dilution from test to test, *i.e.*, a given culture might be inhibited by 8 units in one test and by 16 units in a second. In most instances the end-point was the same in repeated trials.

Strain W of *E. coli* was used to control all tests and this culture was inhibited regularly by 4 units of streptomycin per ml of medium. The *Salmonella* strains in general were more resistant; the great majority of the types were inhibited by 8 to 16 units per ml. Space does not permit the separate listing of all the types tested but it may be said that with the exception of the types enumerated below and the cultures given in Table I, all the cultures were inhibited either by 8 or 16 units of streptomycin per ml. *S. typhi* *suis*, *S. duesseldorf*, *S. sendai* and *S. poona* were inhibited by 2 units of streptomycin per ml, while 4 units were required to inhibit *S. abortus-ovis*, *S. muenchen*, *S. dublin*, *S. rostock*, *S. moscow*, *S. blegdam*, *S. selandia*, *S. hvittingfoss*, *S. minnesota*, *S. melagris*, *S. orion*, and *S. pretoria*. Those cultures which were more resistant than the majority of the types required 32 units per ml to inhibit growth. Among this group were *S. amager*, *S. californica*, *S. manhattan*, *S. alton*, *S. simsbury*, *S. mississippi*, *S. tennessee*, *S. florida*, *S. madelia*, and *S. heves*.

In Table I are listed 252 cultures of 19 of the types frequently encountered. Different cultures of the same type vary widely in their sensitivity to streptomycin and it is unwise to draw conclusions regarding the susceptibility of a given type unless several cultures are

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TABLE I.
Inhibition of *Salmonella* Cultures by Streptomycin.

Type	No. of cultures tested	No. of cultures inhibited by units per ml of medium					
		1	2	4	8	16	32
<i>S. paratyphi</i> A	8		1	6	1		
<i>S. paratyphi</i> B	24			2	13	7	2
<i>S. typhi-murium</i>	28			2	13	9	4
<i>S. derby</i>	12		1	1	8	2	
<i>S. paratyphi</i> C	3				3		
<i>S. cholerae-suis</i>	12			5	5	1	1
<i>S. cholerae-suis</i> var. <i>kunzendorf</i>	16			1	7	8	
<i>S. montevideo</i>	12				4	7	1
<i>S. oranienburg</i>	13			2	9	2	
<i>S. bareilly</i>	11				6	4	1
<i>S. newport</i>	14		1	5	4	4	
<i>S. typhi</i>	8		1	6	1		
<i>S. enteritidis</i>	14		2	7	3	2	
<i>S. pullorum</i>	18	1	1	8	7	1	
<i>S. gallinarum</i>	16		1	5	7	3	
<i>S. anatum</i>	11				4	6	1
<i>S. gire</i>	11				4	6	1
<i>S. newington</i>	11			1	2	4	4
<i>S. scotlandberg</i>	10			1	4	4	1
<i>E. coli</i> W	1			1			

examined. Results obtained with only one or 2 cultures of a given type are only a tentative indication of the susceptibility of that type to the substance. In general, it may be said that *S. paratyphi* A and *S. typhi* were quite susceptible to the action of streptomycin while *S. pullorum* and *S. enteritidis* were inhibited by relatively low concentrations. The remainder of the commonly occurring *Salmonella* types were decidedly more resistant. It is of interest that not only was *S. enteritidis* one of the more easily inhibited types, but the closely related forms, *S. dublin*, *S. rostock*, *S. moscow*, and *S. blegdam*, were also inhibited by low concentrations of streptomycin.

Summary. The *in vitro* inhibition of 412 cultures of *Salmonella* by streptomycin was

studied. All of the recognized types in the genus were included in the work. Of the commonly occurring types, *S. paratyphi* A and *S. typhi* were the most sensitive while *S. pullorum* and *S. enteritidis* were somewhat less susceptible. The remainder of the types which are found frequently were more resistant. The majority of the types required 2 to 4 times as much streptomycin to inhibit growth as did *E. coli* W. Different cultures of the same type often varied widely in their susceptibility to streptomycin.

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