14582

Bacteriostatic Activity of Sulfonamides Against *B. morganii* and Paracolon Bacilli.

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During recent years suggestive evidence has been obtained indicating that *B. morganii* type I and paracolon bacilli may play a role in enterocolitis and gastroenteritis (Stuart, Wheeler, Rustigian, and Zimmerman,[1] Neter and Bender,[2] and others). It seemed of interest, therefore, to determine whether or not these organisms are susceptible to the action of sulfonamides *in vitro* as a preliminary study to an investigation on the chemotherapeutic effectiveness of these drugs *in vivo*. Sulfasuccidine seems to be the drug of choice at the present time in the treatment of localized enteric infections amenable to sulfonamide therapy. Since the *in vitro* activity of sulfasuccidine does not parallel its *in vivo* effectiveness, the following experiments were carried out with sulfanilamide and sulfathiazole.

Material and Methods. Several freshly isolated strains of *B. morganii* type I and paracolon bacilli were used in this study. The strains were recovered from the feces of infants and children with diarrheal disease. The biochemical reactions of the strains of *B. morganii* were characteristic of this species. The paracolon bacilli produced acid and gas from glucose, but failed to ferment lactose even when the incubation period was extended over 3 weeks.

The strains were grown for 24 hours at 37°C in infusion broth and tryptone, respectively. The bacteriostatic activity of sulfonamides was tested in 1% glucose-phenol red broth (Difco). This broth contained beef extract, protose peptone No. 3, sodium chloride, and phenol red. Sulfanilamide was added to give concentrations of 10 mg %, 100 mg %, and 1,000 mg %, and sulfathiazole to give a concentration of 100 mg %. Broth without sulfonamides was used as a control. These culture media were sterilized by autoclaving at 15 lbs pressure for 12 minutes. To 5 ml of these broths was added 0.2 ml of a 1:10,000 diluted broth culture of the respective microörganisms. The tubes were then incubated at 37°C and the resulting growth was noted at various intervals.

Results. Table I presents the results of the bacteriostatic action of sulfanilamide and sulfathiazole toward 3 strains of *B. morganii* and 3 strains of paracolon bacillus. It is evident from this table that these 6 strains were susceptible to the bacteriostatic activity of both sulfanilamide and sulfathiazole. Sulfathiazole in concentrations of 100 mg % was slightly more effective than sulfanilamide in like concentration. On the other hand, sulfanilamide in a concentration of 1,000 mg % exerted greater bacteriostatic activity than sulfathiazole in a concentration of 100 mg %. As a matter of fact, it permanently (7 days) prevented visible growth of all strains tested. In no instance was sulfanilamide in a concentration of 10 mg % effective, even after a period of only 6 or 8 hours. Eight additional strains of *B. morganii* type 1 and paracolon bacillus were tested. Essentially identical results were obtained.

Within the genus *Salmonella* there exist differences in susceptibility to sulfonamides among the different species (Bornstein and Strauss[3]). According to Bornstein,[4] sulfaguanidine showed a strong bacteriostatic action on *S. choleræ suis; S. paratyphi A* was fairly well inhibited. All other types were either entirely resistant or inhibited only by

[1] Stuart, C. A., Wheeler, K. M., Rustigian, R., and Zimmerman, A., *J. Bact.*, 1943, **45**, 101.

[2] Neter, E., and Bender, N. C., *J. Pediat.*, 1941, **19**, 53.

[3] Bornstein, S., and Strauss, L., PROC. SOC. EXP. BIOL. AND MED., 1941, **47**, 112.

[4] Bornstein, S., *J. Immunol.*, 1943, **46**, 439

TABLE I.
Bacteriostatic Activity of Sulfanilamide and Sulfathiazole Against *B. morganii* and Paracolon Bacillus.

Strain	Incubation at 37°C	Sulfanilamide 10 mg%	Sulfanilamide 100 mg%	Sulfanilamide 1,000 mg%	Sulfathiazole 100 mg%	Control
B. morganii						
No. 3411	6 hr	++	—	—	—	+—
	24 "	++++	++++	—	++++	++—+
	7 days	++++	++++	—	++++	
No. 3156	8 hr	++++	++++	—	—	++++
	24 "	++++	++++	—	—	++++
	7 days	++++	++++	—	++++	
No. 2688	8 hr	++++	++++	—	++	++++
	24 "	++++	++++	—	++++	++++
	7 days	++++	++++	—	++++	++++
Paracolon bacillus						
No. 3481	8 hr	++	—	—	—	++
	24 "	++++	++++	—	+	++++
	7 days	++++	++++	—	++++	
No. 2869	8 hr	++++	—	—	—	++++
	24 "	++++	++++	—	—	++++
	7 days	++++	++++	—	++++	
No. 2959	8 hr	++	—	—	—	++
	24 "	++++	++++	—	++	++++
	7 days	++++	++++	—	++++	++++

—: No visible growth.
+ to ++++: Various degrees of visible growth.

strong concentrations, much higher than those inhibiting the growth of *B. coli*. The possibility was considered that similar differences may exist between members of the genus *Escherichia* and the paracolon bacilli. To investigate this problem, Endo agar and SS (Salmonella-Shigella) agar with and without sulfanilamide were inoculated with feces from patients with diarrheal disease. Preliminary studies revealed that sulfanilamide inhibited both *B. coli* and paracolon bacilli. Thus, addition of this drug to selective and differential culture media does not produce a higher percentage of isolations of paracolon bacilli from fecal specimens.

Summary. (1) Sulfanilamide and sulfathiazole exert bacteriostatic activity toward *B. morganii* type I and paracolon bacillus. (2) Sulfathiazole in a concentration of 100 mg % is somewhat more effective than sulfanilamide in like concentration, but is less growth-inhibitory than sulfanilamide in a concentration of 1,000 mg %.