

NOTES

ANTIBACTERIAL ACTION OF CANDIDA

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A recent communication (Soc. Hell. Microbiol., 26 Jan., 1960) presented the antibacterial action of some *Candida* strains against one strain of *Bacillus subtilis*. In this note we present the same action of 94 strains of *Candida* against 20 strains of *Escherichia coli*, 20 strains of *Staphy-*

the strains of the above mentioned bacteria were isolated from feces, except a few strains of *S. aureus* and *P. aeruginosa* which were isolated from the throats of the children.

The test for the antibacterial action of the *Candida* was studied by spreading a light sus-

TABLE 1

Mean number and percentage of strains of Candida inhibiting the growth of bacteria*

Bacteria Tested and No. of Strains	<i>Candida albicans</i> , 84 Strains		Other Species of <i>Candida</i> , 10 Strains		χ^2 of Differences of the Mean No. of Strains
	Mean no. of inhibiting strains	Percentage of inhibiting strains	Mean no. of inhibiting strains	Percentage of inhibiting strains	
<i>Escherichia coli</i> 20 strains.....	78.2	93.1	2.2	22.0	56
<i>Staphylococcus aureus</i> 20 strains.....	71.3	84.8	1	10.0	29
<i>Proteus vulgaris</i> 7 strains.....	82.7	98.4	6.4	64.0	23
<i>Pseudomonas aeruginosa</i> 5 strains.....	82.2	97.8	6.2	62.0	20
Total.....	78.6	93.5	3.8	38.0	26

* The mean number of inhibiting strains of *Candida* (84 strains of *C. albicans* and 10 other species) calculated as follows:

For example, in the first entry, the mean number of inhibiting strains of *Candida* for 20 strains of *E. coli* was 78.2. The first strain of *E. coli* was inhibited by the antibacterial action of 79 strains of *C. albicans* out of the 84, and not inhibited by 5; the second strain of *E. coli* was inhibited by 80 strains of *C. albicans*, and not by 4; etc. We obtained thus a column of 20 numbers ranging between 71 and 82. By adding these numbers and dividing by 20, we got 78.2, which shows that slightly more than 78 (93.1 per cent) out of the 84 strains of *C. albicans* inhibited the growth of the 20 strains of *E. coli*.

The same method of calculation has been applied for the other species of bacteria tested.

lococcus aureus, 7 strains of *Proteus vulgaris*, and 5 strains of *Pseudomonas aeruginosa*. Of the 94 strains of *Candida*, 84 were *Candida albicans*, and 10 belonged to other species; i. e., 4 strains were *Candida parakrusei*, 3 were *Candida tropicalis*, 2 were *Candida pseudotropicalis*, and 1 was *Candida guilliermondii*. All *Candida* strains were isolated from the throats of children admitted to the Hospital for pharyngeal infections, whereas

pension of a 24-hr culture of the test bacteria on the surface of a soft (1.2 per cent agar) Sabouraud glucose agar plate. On the same surface, after drying it for 10 min in the incubator, strains of *Candida* were inoculated by scratching the agar slightly with the loop in an area of about 3 mm in diameter for each strain. After 24 hr incubation at 37 C, a clear zone of inhibition of growth of the bacteria around the area of growth

of most of the *Candida* strains tested was noticed, whereas the rest of the surface was covered with a thin layer of bacterial growth.

Table 1 shows the mean number and the percentage of strains of *C. albicans*, as well as *Candida* of other species which inhibit the growth of the tested bacteria. The standard deviations of these mean numbers, for the 84 strains of *C. albicans*, were quite low, but for the 10 strains of the other species of *Candida*, they were high. However, the χ^2 values of the differences of these mean numbers were very high.

We may note the following: (a) The antibacterial action of *C. albicans* against the tested bacteria is considerably stronger than that of

the other species of *Candida*. (b) The antibacterial action of each strain of *C. albicans* differs from that of other strains. Some strains inhibit every bacteria tested, others only few. (c) The gram-negative bacteria are more sensitive than staphylococci to the antibacterial action of the *Candida* and specially *P. vulgaris* and *P. aeruginosa*. The zone of inhibition with the last-named bacteria is larger than with *E. coli* (2 to 3 cm) and it is considerably smaller with *S. aureus*. (d) With some strains of *C. parakrusei* we noticed an enhancement of the growth of the tested bacteria accompanied with a depression of the growth of this *Candida*.

LYSOGENY OF *BACTERIUM ANITRATUM*

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Study of 20 strains of *Bacterium anitratum* showed that they are frequently lysogenic and produce phages active against one or more sensitive indicators.

The strains used in this work were kindly supplied by Dr. M. Mathiesen, Statens Serum-institut, Copenhagen, who used them for other purposes (Acta Pathol. Microbiol. Scand., **41**, 247, 1957). Two of these strains (no. 13 and no. 18) do not belong serologically to *B. anitratum*, but they behave biochemically as *B. anitratum* and were included in our experiments.

Before the study of lysogeny, tests for bacteriocinogeny were carried out with all these strains, as it is not known whether *B. anitratum* produces bacteriocins which might simulate phages, in the soft agar layer method used in this work. The bacteriocinogeny was studied by the following method of Fredericq (Ann. Rev. Microbiol., **11**, 7, 1957). Each strain of *B. anitratum* was streaked in the center of a nutrient agar plate and incubated at 37 C for 48 hr. The other 19 strains were streaked perpendicularly against the initial culture. Readings were made after 24 hr.

None of the 20 strains produced bacteriocins active against the other strains and all were considered suitable for the study of the lysogeny.

Lysogeny was studied by several methods.

TABLE 1
Lysogeny of Bacterium anitratum

Strain No.	No. of Strains Sensitive to Lysogenic Strain	Sensitive to Phages Produced by Other Strains
T	4	28
A12	2	Resistant
20	4	14
21	2	28, 30, 14, 13, 18, 2059, 39, 12
28	5	Resistant
29	1	30
30	5	2129, 39, 20, B5W
B5W	5	2129, 2059, 1983, T, 24, 35
35	3	Resistant
40	0	28, 2129, 30, 14, 36, 13, 18, 2059, 1983, T, 24, 20, 35, B5W, 12, 21, 29, 33
1983	3	2129, 30, 36, 39, T, 24, 20, 33
2129	5	Resistant
13	2	Not used as indicator
14	4	Resistant
18	2	B5W
24	4	B5W
33	2	28, 2129, 30, 14, 36, 1983, T, 24, 20, B5W, 21, 35
36	3	Resistant
39	3	28
2059	3	Not used as indicator