found to be lacking in sufficient available methionine to produce growth equal to that elicited by an equivalent amount of casein. It appears that this fact is one limiting factor which must be considered in evaluating yeast protein as a replacement for animal proteins.

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Penicillin Sensitivity of Strains of Non-hemolytic Streptococci Isolated from Cases of Sub-acute Bacterial Endocarditis.

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It is generally recognized that different organisms vary greatly in their sensitivity to penicillin and that even different strains of the same organism exhibit wide variations in susceptibility. In the treatment of human infections the importance of determining the sensitivity of the infecting strain is therefore obvious. In view of the apparent success which has recently been achieved in the treatment of cases of sub-acute bacterial endocarditis with penicillin,[1,2] information on the penicillin sensitivity of strains isolated from this disease is particularly desirable.

Fifty strains of non-hemolytic streptococci obtained from cases of sub-acute bacterial endocarditis were studied.

Gross Description. Of 50 strains examined:

19 were described as "viridans"
12 " " " "indifferent"
3 " " " "resembling enterococci"
2 exhibited 2 types of colonies
1 was described as "weakly hemolytic"
13 were not described, other than as "non-hemolytic"

Serological Grouping. Thirty-nine strains were examined serologically according to Lancefield's procedure. Of these, 10 fell into definite groups as follows:

Group B	1 strain
" C	2 strains
" D	1 strain
" F	2 strains
" H	4 "

In addition, 6 strains showed an antigenic relationship to one or other of the groups but could not be definitely classified. Twenty-three strains showed no relationship to any of the groups for which they were tested. Eleven strains were not tested serologically.

Penicillin Sensitivity. The sensitivity of non-hemolytic streptococci was determined by the following procedure:

The sensitivity of each strain was compared with that of a standard strain of hemolytic streptococcus (C203MV). It had been shown previously that from 0.01 to 0.03 Oxford units are required to inhibit the growth of a 10^{-2} dilution of a 15-hour rabbit's blood broth culture of this strain. Such a dilution contains from 2,500,000 to 3,000,000 organisms. In other experiments it had been shown that the *in vitro* activity of penicillin is influenced by the number of organisms present and by the rate of growth of the organisms. The unknown strains were therefore tested under growth conditions comparable with those of the standard strain. The cultures to be examined were grown for 15 hours in rabbit's blood broth, the original seeding being such as to produce growth of approximately the same density as that of a 15-hour culture of strain C203MV. If the unknown strain grew too heavily the 15-hour culture was diluted with broth to a turbidity equivalent to that of the standard. If the unknown strain grew too lightly, a 10^{-1} dilution was used for the test instead of a 10^{-2} dilution. If extremely heavy or very sparse growth occurred, a more suit-

[1] Loewe, L., Rosenblatt, P., Greene, H. J., and Russell, M., *J. A. M. A.*, 1944, **124**, 144.

[2] Dawson, M. H., and Hobby, G. L., *J. A. M. A.*, 1944, **124**, 611.

able 15-hour culture was obtained by using a more appropriate seeding.

Two sets of serial dilutions of penicillin in plain broth containing 8, 4, 2, 1, 0.5, 0.25, 0.12, 0.06, 0.03, 0.015 units per cc respectively were then prepared. To the first set was added a sufficient amount of a 15-hour rabbit's blood broth culture of the standard strain to give a final dilution of 10^{-2}. To the second set was added a similar amount of the unknown strain. Both sets were then incubated at 37° C overnight and the titers read the following day.

The least amount of penicillin (units per cc) which inhibited growth as evidenced by absence of turbidity, was accepted as the "titer." The "titer" of the unknown strain was compared with that of the standard strain and the relative sensitivity of the 2 strains was recorded. For example, if 0.03 units were required to inhibit growth of the standard strain and 0.06 units the unknown strain, the unknown strain was considered to be one-half as sensitive.

The sensitivity of 41 strains compared with that of the standard strain of hemolytic streptococcus was found to be as follows:

1 strain was twice as sensitive
8 strains were equally as sensitive
23 strains were ¼ to ½ as sensitive
4 strains were ⅛ as sensitive
2 strains were 1/16 as sensitive
1 strain was 1/64 as sensitive
2 strains were highly resistant

Analysis of the sensitivity of the strains according to the gross description revealed the following:

(a) Of 19 strains described as "viridans"
1 was twice as sensitive
2 were equally as sensitive
10 were ¼ to ½ as sensitive
2 were 1/16 as sensitive
1 was 1/64 as sensitive
1 was resistant
2 were not tested for sensitivity

(b) Of 12 strains described as "indifferent"
3 were equally as sensitive
6 were ¼ to ½ as sensitive
3 were not tested

(c) Of 3 strains described as "resembling enterococci"
1 was equally as sensitive
1 was ½ as sensitive
1 was resistant

Analysis of the sensitivity of strains according to serological grouping showed that of the 10 strains which fell into definite serological groups, all except one were either equally as sensitive or ¼ to ½ as sensitive as the standard strain. One strain belonging to Group H was ⅛ as sensitive.

Previous work in this laboratory has shown that the majority of strains of staphylococci isolated from human infections are from 2 to 8 times more resistant to penicillin than the standard strain of hemolytic streptococcus employed in the present investigation.

Conclusions. With occasional exceptions strains of non-hemolytic streptococci isolated from cases of sub-acute bacterial endocarditis are sensitive to penicillin *in vitro*. The degree of sensitivity is approximately the same as that shown by strains of staphylococci isolated from human infections but is not as great as that exhibited by hemolytic streptococci. The degree of sensitivity of any particular strain does not correspond with the cultural or serological properties of the strain. In the treatment of each individual case, the sensitivity of the infecting strain should be determined as a guide to appropriate therapy.