tract must be prepared. Rabbits, however, are not sensitive and can be used.

Further study of a sensitizer-free insulin anti-protease mixture seems to be warranted. Other sources of the anti-protease are being investigated. Perhaps, if combined with some substance aiding absorption such as desoxycholic acid or saponin,[7] the insulin polypeptide, protected from hydrolysis, might be absorbed and exert its effect when administered *per os.*

6432

## Fermentation of the d- and l- Forms of Arabinose by Bacteria.

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Although the commoner sugars have found an every day use in bacteriological technic for the separation and characterization of different types of bacteria, it is only rarely that optical antipodes have been subjected to comparative fermentation tests for the purpose of correlating sugar structure with utilization.[1] In most cases it is difficult or impossible to prepare both the *d-* and *l-* forms of a given sugar. Arabinose is one of the few exceptions to this rule.

The common form of arabinose is *l*-arabinose[2] ($[\alpha]_D = +105°$), which occurs naturally in a combined form in many gums such as arabic and mesquite. It has been used in bacteriological work for a number of years. *d*-arabinose seldom occurs naturally and must be prepared from *d*-glucose by degradation. Recently we obtained* a supply of *d*-arabinose which had been prepared by the oxidation of calcium gluconate with hydrogen peroxide in the presence of ferric acetate. This afforded us an opportunity to study the fermentation of both *d*-arabinose and *l*-arabinose, which are exact opposites in configuration and rotation.

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[7] Collens, W. S., and Goldzieher, M. A., PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 756.

[1] Kendall and Gross, *J. Infect. Dis.*, 1930, **47**, 249. Lester, *Acta Path. Microbiol. Scandanavica*, 1926, **3**, 696.

[2] The symbols *d-* and *l-* in connection with sugars refer to family relationships and not to the sign of rotation. See Rosanoff, *J. Am. Chem. Soc.*, 1906, **28**, 114.

* We are indebted to Dr. W. C. Austin of the Department of Physiological Chemistry of Loyola University for the supply of *d*-arabinose.

The sugar solutions were sterilized by filtration through Seitz filters and added to nutrient broth to give a 1% solution of sugar in the culture medium. After inoculation the various cultures were held at 37° and observed at frequent intervals for 3 weeks. The results are shown in the accompanying table.

The common *l*-arabinose was fermented rapidly by many bacteria. It is quite striking that the synthetic *d*-arabinose was fermented with difficulty by all of the types which utilized *l*-arabinose readily. An interval of 4 to 7 days, or occasionally longer, was required for the break down of the *d*-arabinose to acid end products. Since all cultures developed readily in the *d*-arabinose broth it seems certain

TABLE I.
Fermentation of the 2 forms of arabinose.

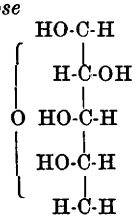
| Organisms | No. Strains used | *l-arabinose** | *d-arabinose* |
|---|---|---|---|
| *Proteus vulgaris* | 3 | 0 | + |
| *B. coli* | 5 | + | + (2) |
| *B. aerogenes* | 6 | + | + (3 to 5), 1 culture negative |
| *B. friedländeri* | 4 | + | + (4), 1 culture negative |
| *S. paratyphosum* | 1 | + | + (5) |
| *S. schottmülleri* | 2 | + | + (5 to 14) |
| *S. aertrycke* | 2 | + | + (3 to 8) |
| *S. enteritidis* | 2 | + | + (3 to 4) |
| *S. cholerae-suis* | 2 | 0 | + (6 to 10) |
| *E. typhi* | 2 | 0 | 0 |
| *E. dysenteriae*, Flexner | 2 | + | 0 |
| *E. dysenteriae*, Sonne | 2 | + | + (8 to 10) |
| *Coryn. diphtheriae* | 2 | 0 | 0 |
| *Sarcina lutea* | 1 | 0 | 0 |
| *Staph. aureus* | 1 | 0 | 0 |
| *Staph. albus* | 1 | 0 | 0 |
| *Streptococci*, various | 6 | 0 | 0 |
| *Pneumococci*, I, II, III | 3 | 0 | 0 |
| *B. subtilis* | 1 | 0 | 0 |
| *B. megatherium* | 1 | 0 | 0 |
| Yeasts | | | |
| *Sacc. cerevisiae* | 1 | 0 | 0 |
| *Torula cremoris* | 1 | 0 | 0 |

+ = prompt fermentation as shown by production of acid, or both acid and gas within 24 hours.

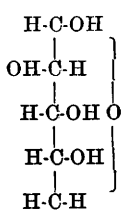
+ ( ) = slow fermentation. The figures in parenthesis give the number of days elapsing before a definite positive test appeared.

0 = no evidence of fermentation.

*Formula for *l-arabinose*




For *d-arabinose*



that the slow fermentation was not due to any restraining effect upon growth of the culture. Fermentation occurred after the peak of the growth curve had been passed.

The behavior of several of the bacteria deserves a special word of comment. The 3 strains of *Proteus vulgaris* all failed to ferment *l*-arabinose but promptly used *d*-arabinose, and seemed to be unique in this respect. This is essentially similar to the finding of Moltke[3] who reported in his monograph on the Proteus group that none of his cultures fermented *l*-arabinose but that all of them fermented *d*-arabinose. It is interesting that such vigorous fermenting types as *Bacterium coli* and *Bact. aerogenes,* both of which are able to break down many varied types of sugars, experienced some difficulty in handling *d*-arabinose. *Salmonella cholerae-suis* is unable to ferment *l*-arabinose and this characteristic has been used as one of the means of separating it from other members of the Salmonella, or paratyphoid, group. It is interesting that this organism produced a delayed fermentation of *d*-arabinose and thus its behavior toward this form of arabinose is similar to that of the other members of the Salmonella group.

A comparison of the 2 forms of arabinose, together with a consideration of the behavior of the organisms toward other pentoses and hexoses, fails to afford an explanation of the results. It is planned to investigate the intermediate metabolism of these sugars in more detail.

6433

## Anomalous Lacrimation.

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A medical student, A. B. B., has been puzzled because during defecation and sometimes during urination, he has noticed a copious flow of tears. Inquiry has indicated that the experience was at least relatively rare, and he has been unable to find reference to this response in the literature.

[3] Moltke, Contributions to the characterization and systematic classification of *Bac. proteus vulgaris.* Levin and Munksgaard, Copenhagen, 1927.

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