formation; no other generation in the life history of the aphid possesses this power. If the stem mother dies or is removed from a developing gall, growth of the gall soon ceases. Tissues differentiated in the gall do not revert to normal leaf tissues.

The gall may be looked upon as a neoplasm. Further studies are planned on the chemistry of the substance causing it to form. A detailed report of observations here summarized is in preparation.

Reference

1. SPIEGELMAN, S., and KAMEN, M. D. *Science*, 1946, **104**, 581-584.

A Relationship Between Cystine and Pyridoxal or Pyridoxamine in the Nutrition of Certain Bacteria

MARVIN L. SPECK and DOROTHY A. PITT

National Dairy Research Laboratories, Inc., Baltimore, Maryland

Cystine has been found to be essential for the growth of *Lactobacillus arabinosus* (*5*) and *L. casei* (*3*), although in a more complete synthetic medium it was reported to be unessential for *L. arabinosus* (*2*).

In experiments designed to assay cystine by *L. arabinosus* 17-5, using the medium of Stokes, *et al.* (*10*), near maximum growth occurred at 37° C. with no cystine added to the medium. It was subsequently found that the pyridoxamine in the medium eliminated the requirement of this organism for cystine (Table 1). Pyridoxal had the same effect, while pyridoxine had little or no effect on growth. Similar results were obtained with *Streptocccus fecalis* and *L. casei*, although cysteine was found by Dunn, *et al.* (*2*) to be essential for *L. casei* in a medium containing pyridoxal and pyridoxamine. The cystine requirement of *L. delbrückii* LD5 and *Leuconostoc mesenteroides* P-60, however, was not affected by the presence of pyridoxamine or pyridoxal, which agrees with results of Dunn, *et al.* (*2*). Similar effects of these compounds on certain other amino acid requirements of various lactic acid bacteria have been reported by Stokes and Gunness (*9*) and Lyman, *et al.* (*4*).

TABLE 1

INTERCHANGEABILITY OF CYSTINE WITH PYRIDOXAL OR PYRIDOXAMINE IN THE NUTRITION OF CERTAIN BACTERIA

(ml. 0.1 N NaOH/10 ml. culture)*

Organism	No cystine; no vitamin B_6	100 γ/ml. cystine; no vitamin B_6	100 γ/ml. cystine + 0.4 γ/ml. pyridoxamine†	No cystine; 0.4 γ/ml. pyridoxamine†	No cystine; 0.4 γ/ml. pyridoxal†	No cystine; 0.4 γ/ml. pyridoxine†
L. arabinosus 17-5 (A.T.C.C. #8014)	1.30	6.20	9.50	7.60	7.95	2.00
L. casei (A.T.C.C. #7469)	1.50	6.50	9.55	7.55	7.95	2.55
Str. fecalis (A.T.C.C. #9790)	1.50	6.60	6.70	5.75	5.90	1.70
Leuc. mesenteroides P-60 (A.T.C.C. #8042)	1.25	3.45	8.80	1.80	1.80	1.90
L. delbrückii LD_5 (A.T.C.C. #9595)	1.15	2.13	10.05	1.78	1.00	0.70

* Medium of Stokes, *et al.* (*10*), except for changes in cystine and vitamin B_6 group noted.

† Seitz-filtered; added aseptically to sterile medium.

When incubated at 30° C. instead of 37° C. with 0.4 γ/ml. of pyridoxamine but no cystine, *L. arabinosus* and *L. casei* grew slightly, while *Str. fecalis* grew almost equally as well as at 37° C. These data indicate that the mechanism whereby pyridoxamine replaces the cystine requirement of these organisms is not necessarily associated with the optimum growth temperatures of the organisms.

Since cystine is essential for *L. arabinosus*, *L. casei* and *Str. fecalis*, their growth in a medium deficient in cystine, but containing pyridoxamine or pyridoxal, indicated that cystine was synthesized from ingredients of the medium. To test this, *L. arabinosus* and *Str. fecalis* were grown 3 days at 37° C. and *L. casei* 6 days at 37° C. in the medium of Stokes, *et al.* (*10*) containing 0.4 γ of pyridoxal/ml. (Seitz filtered; added aseptically), but from which cystine was omitted. The washed cells were acid hydrolyzed and the hydrolysates assayed by *Leuc. mesenteroides* P-60. *L. arabinosus* contained 0.38 per cent, *L. casei* 0.65 per cent, and *Str. fecalis* 0.26 per cent cystine on the basis of dried cells. The cystine thus formed may originate from methionine, as shown by Tarver and Schmidt (*11*) to occur in rats fed methionine containing isotopic sulfur, and/or from serine, as reported by Stetten (*8*) to occur in rats fed serine containing isotopic nitrogen. Whatever the origin of the cystine, pyridoxal and pyridoxamine have an essential role in its synthesis in such a medium.

Some of the irregularities reported in the microbiological assay of cystine by *L. arabinosus* and *L. casei* (*1, 6*) can probably be explained by the presence of pyridoxal or pyridoxamine in the medium or in samples assayed. Also, a medium deficient in cystine but containing 0.4 γ of pyridoxine/ml., sterilized by autoclaving at 15 pounds pressure for 13 minutes, permitted considerable growth of these cultures. This was probably a result of pyridoxamine being formed by the interaction of pyridoxine and amino acids in the medium during sterilization (*7*), and indicates another reason for irregularities in the assay of cystine by *L. casei* and *L. arabinosus*. Furthermore, since temperatures from 30° to 37° C. are used for the growth of these bacteria, the degree to which pyridoxal and pyridoxamine contained in the medium replace the requirement for the added cystine varies with the particular temperature of incubation.

References

1. BAUMGARTEN, W. *Cereal Chem.*, 1945, **22**, 311.
2. DUNN, M. S., SHANKMAN, S., CAMIEN, M. N., and BLOCK, H. *J. biol. Chem.*, 1947, **168**, 1.
3. HUTCHINGS, B. L., and PETERSON, W. H. *Proc. Soc. exp. Biol. Med.*, 1943, **52**, 36.
4. LYMAN, C. M., MOSLEY, O., WOOD, S., BUTLER, B., and HALE, F. *J. biol. Chem.*, 1947, **167**, 177.
5. SHANKMAN, S. *J. biol. Chem.*, 1943, **150**, 305.
6. SHANKMAN, S., DUNN, M. S., and RUBIN, L. B. *J. biol. Chem.*, 1943, **151**, 511.
7. SNELL, E. E. *J. biol. Chem.*, 1944, **154**, 313.
8. STETTEN, D., JR. *J. biol. Chem.*, 1942, **144**, 501.
9. STOKES, J. L., and GUNNESS, M. *Science*, 1945, **101**, 43.
10. STOKES, J. L., GUNNESS, M., DWYER, I. M., and CASWELL, M. C. *J. biol. Chem.*, 1945, **160**, 35.
11. TARVER, H., and SCHMIDT, C. L. A. *J. biol. Chem.*, 1939, **130**, 67.