

CERTAIN ASPECTS OF THE RESPIRATION OF  
**PARAMECIUM CAUDATUM**<sup>1</sup>

(Abstract)

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The organism used in these studies was **Paramecium caudatum**, variety 2, Type IV, as classified by Gilman (1), which had been isolated from Lake Poinsett. The paramecia were grown in four liter bottle cultures in a dried milk medium. The organisms, after concentration, were centrifuged and washed in sterile buffer repeatedly to remove contaminating bacteria. Direct counts and nitrogen determinations were run routinely. The final suspensions contained from 5,000-15,000 organisms per ml.; the organisms had an average nitrogen content of 6.5 milligrammas per organism. All respiration studies were made using the Warburg respirometer; adequate controls were included in each experiment.

When glucose was used as the substrate, most of the R.Q. values ranged from 0.8 to 1.1. The  $Q_{O_2}$  (N) for **P. caudatum** was found to range from 40-300, which compares well with those values reported in the literature (80-860) for this particular organism, as well as with tissues such as liver and yeast. A study of the effect of azide and cyanide on the respiration of this gave results similar to those reported by Boell (2). Inhibition up to 90% was obtained with  $10^{-2}$ M KCN; approximately 50% with  $10^{-3}$  M KCN. 50% inhibition was noted with  $10^{-2}$   $NaN_3$ . This sensitivity to cyanide and azide suggests the possibility of a respiratory system in **P. caudatum** which includes the cytochrome system.

Many inhibitors have been reported for vitamins, amino acids, purines and pyrimidines. These inhibitors have been studied primarily using bacteria. Grover and Shaw (3), two years ago at these meetings, reported the killing effect of thiourea on **P. caudatum**. The inhibition of respiration

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by thiourea and thiouracil has been studied in this report. Thiourea ( $10^{-4}$ M) had a very marked inhibitory effect on respiration; the inhibitory effect could be almost completely removed by the addition of  $10^{-1}$  or  $10^{-2}$ M urea, and less strikingly removed by  $10^{-2}$  uracil. (Figure 1).

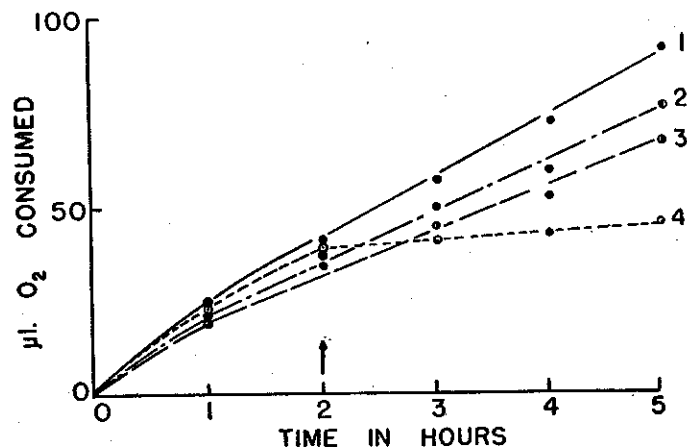


Fig. 1. Inhibition of Respiration in *Paramecium caudatum* by Thiourea. All Contain 0.04 M Glucose.

Additions:

- Curve 1. None
- Curve 2. 0.1 M Urea and 0.0001 M Thiourea
- Curve 3. 0.01 M Uracil and 0.0001 M Thiourea
- Curve 4. 0.0001 M Thiourea

Thiouracil ( $10^{-3}$ M) also inhibited the respiration of *P. caudatum*; this inhibition could be nullified to a great extent by  $10^{-2}$ M uracil. Because of the structural similarity between thymine (5-methyl uracil) and uracil, it was also used in attempts to remove this inhibition. Surprisingly, in view of its presence in desoxyribosenucleic acid, it also seemed to be inhibitory at  $10^{-2}$  M concentration. (Figure 2).

The respiration of *P. caudatum*, as exhibited by oxygen uptake in the Warburg apparatus, is comparable to that of other tissues on a nitrogen basis. In view of the sensitivity of this organism to azide and cyanide, it is probable that the respiratory system resembles that in other tissues. The removal of the inhibitory effect of thiourea and thiouracil by urea and uracil suggests that this effect might conceiv-

ably be the same as that postulated for the metabolite-inhibitor relationships studied with bacteria—interference with the utilization of a specific substrate in an enzyme system.

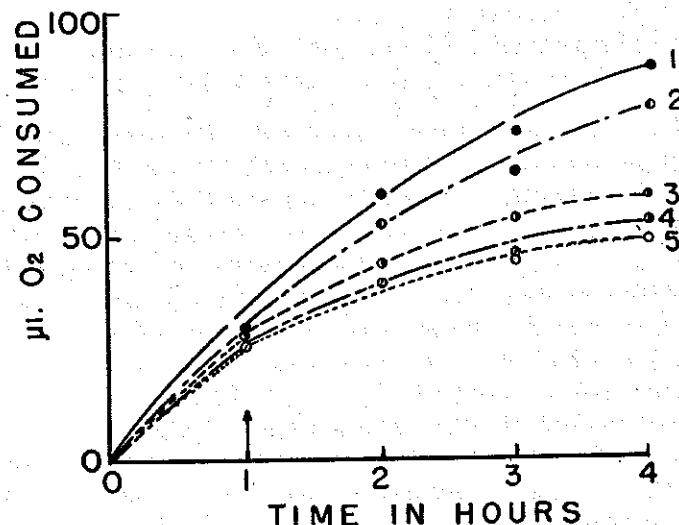


Fig. 2. Inhibition of Respiration in *Paramecium caudatum* by Thiouracil and Thymine. All contain 0.04 M Glucose

Additions:

- Curve 1. None
- Curve 2. 0.01 M Uracil and 0.001 M Thiouracil
- Curve 3. 0.001 M Thiouracil
- Curve 4. 0.01 M Thymine and 0.001 M Thiouracil
- Curve 5. 0.01 M Thymine

#### BIBLIOGRAPHY

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3. Grover, W. W., and E. H. Shaw, Jr., A Preliminary Report on the Mechanism of the Toxic Action of Thiourea to *Paramecium caudatum*. Proc. S. D. Acad. Sci., **26**, 85 (1946-47).