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Caloric Recalculation

Dear Sir:

In a recent paper Minkoff and Damadian (1) claim that insufficient energy is available from the use of ATP in *Escherichia coli* cells in "minimum energy state" to power six solute pumps which they investigated. This claim is based on a consideration of the measure P/O ratio in these cells; together with the ATP content and a value for the free energy of ATP hydrolysis, this allows the rate of energy production for ATP-dependent pumping to be calculated. The measured P/O of 0.085 in the minimum energy state is lower than that found by van der Beek and Stouthammer (2) in "resting" bacteria, including *E. coli*, i.e., 0.3–1.0. The low value of P/O obtained by Minkoff and Damadian could be due to an underestimate of the rate of ATP turnover. They measured this by supplying $^{32}P_i$ in the medium, and measuring the incorporation of label into the γ-phosphate of ATP. The implicit assumption here is that the specific activity of the orthophosphate used in oxidative phosphorylation is the same as that of the exogenous phosphate. This is unlikely to be true; the rate of labeling of ATP is likely to be limited under these conditions by the rate of ^{32}P uptake into the intracellular orthophosphate pool. The data of Weiden et al. (3) for phosphate uptake and inorganic phosphate pool size in growing *E. coli* suggest that the half-time of labeling of this pool is 1 min, while the half-time of ATP labeling in *E. coli* measured by Minkoff and Damadian is 1.5 min. The agreement between these two values is close and suggests that Minkoff and Damadian have underestimated the ATP turnover due to the slow orthophosphate uptake rate.

Thus it is possible that the P/O ratio could be as high as 1.0 under these circumstances; this would allow adequate ATP for the solute transport processes under investigation. A further point releated to the energy supply for solute transport is the evidence that oxidative phosphorylation could power solute fluxes in prokaryotes directly via a proton gradient (4), i.e., ATP would be an alternative to solute transport. A P/O of 1 would allow adequate energy supply to solute pumps via H^+ gradients.

Received for publication 4 April 1973.

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