

THE UPTAKE OF NONYL AND TETRADECYL BENZYLDIMETHYLAMMONIUM COMPOUNDS BY ESCHERICHIA COLI

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Studies of the uptake of quaternary ammonium compounds (QACs) by bacteria have been reported by several authors including Salton (1951), Salt and Wiseman (1968) and Hugo and Frier (1969). Most of the uptake isotherms described in these reports have corresponded in shape to the simple L type in the classification system of Giles et al (1960). The isotherms described by Salt and Wiseman, however, for the uptake of cetyltrimethylammonium bromide by E. coli, were of a more complex form equivalent to the combination of an S type at low concentrations followed by a C type at higher concentrations and classified by Giles et al (1974) as a subgroup of the C class.

The present communication describes some of the results of a study of the uptake of alkyl benzyldimethylammonium compounds by E. coli. The organism used was E. coli NCTC 1093 grown in a mineral salts medium buffered at pH 7.4 with MOPS and with glucose as the carbon source. Cells were harvested from exponentially growing cultures, washed with and resuspended in glucose-free growth medium. Solutions of nonyl or tetradecyl benzyldimethylammonium salts were then added to the cell suspensions and reaction allowed to proceed for 15 minutes. The cells were then removed by centrifuging and the QACs in the supernatant fluids assayed by the method of Chin and Lach (1965). Corrections were made for uptake by glassware and the cellular uptakes determined by difference.

For both compounds the uptake isotherms observed were qualitatively similar to those described by Salt and Wiseman with an S type region at low concentrations having a plateau approximating to the uptake of a theoretical double layer of molecules at the cell "surface" followed by further linear C type uptake at higher concentrations. The secondary uptake finally terminated with a "saturation" plateau equivalent to the uptake of about eight theoretical monolayers at equilibrium concentrations equal to the critical micelle concentrations of the compounds in glucose free growth medium. Isotherms for the two compounds with uptakes plotted as theoretical monolayers and equilibrium concentrations as fractions of the CMC gave almost superimposable curves.

With both compounds the lowest concentrations giving rapid bactericidal activity corresponded to uptakes in the plateau region of the primary S part of the isotherms and it is suggested that this S part represents a "surface" phenomenon whilst the C type uptake at higher concentrations results from penetration inside cells whose permeability barriers have been damaged.

- Chin, T.F. and Lach, J.L. (1965) *J. Pharm. Sci.* 54, 1550-1551.
Giles, C.H. et al. (1960) *J. Chem. Soc.* 3973-3993.
Giles, C.H. et al. (1974) *J. Colloid Interf. Sci.* 47, 755-778.
Hugo, W.B. and Frier, M. (1969) *Appl. Microbiol.* 17, 118-127.
Salt, W.G. and Wiseman (1968) *J. Pharm. Pharmac.* 20, 145-175.
Salton, M.R.J. (1951) *J. Gen. Microbiol.* 5, 391-404.