Short Communications and Preliminary Notes

AN INHIBITORY EFFECT OF α-METHYL-GLUCOSIDE ON GROWTH AND ENZYME SYNTHESIS IN *E. COLI**

by

S. D. WAINWRIGHT

Service de Physiologie Microbienne, Institut Pasteur, Paris (France)

During the course of investigations on induction of enzyme synthesis in the ML 30 strain of *Escherichia coli*, it was observed that low concentrations ($2\ M \times 10^{-4}$) of α-methyl-glucoside retarded for several hours the onset of growth in a synthetic medium[1] containing lactose or maltose as sole carbon source, when the inocula were taken from cells unadapted to the sugar used (Fig. 1, curves D–F). However, once growth had started in such cultures there was little or no inhibitory action

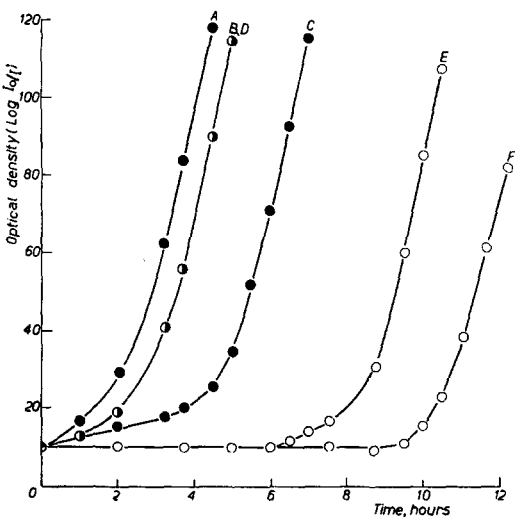

Fig. 1. The influence of α-methyl-glucoside upon growth of lactose-adapted and unadapted cells in synthetic medium with lactose as sole carbon source.
Solid symbols. Cells pre-adapted to lactose by growth with lactose as carbon source
Open symbols. Unadapted cells grown with glucose as carbon source
Curves. A and D. Controls without α-methyl-glucoside
B and E. Concentration of α-methyl-glucoside $2 \cdot 10^{-4}\ M$
C and F. Concentration of α-methyl-glucoside $2 \cdot 10^{-3}\ M$
Cultures grown at 37° C in a medium consisting of 7 ml of synthetic medium 56[1], $M/2400$ lactose, α-methyl-glucoside and water to 8 ml. Inocula: approximately 70 μg dry wt. of cells.

of α-methyl-glucoside, even at a concentration of $4 \times 10^{-3}\ M$. With inocula of cells pre-adapted to these sugars the glucoside exerted only a slight inhibitory action (Fig. 1, curves A–C). Concentrations of α-methyl-glucoside of up to $M/50$ caused no retardation of the onset of logarithmic growth when

* This work was performed while the author held an exchange fellowship of the Medical Research Council (London). Present address: Biology Division, Atomic Energy of Canada Ltd., Chalk River, Ontario (Canada).

glucose was the carbon source. Parallel results were obtained in a study of the influence of α-methyl-glucoside upon the adaptation of *E. coli* to the oxidative metabolism of lactose and maltose. The glucoside would not itself support the growth of *E. coli*, nor was it metabolised, as measured by growth, oxygen consumption or the release of free glucose.

The adaptive formation, by stock cell suspensions[2], of the nitratase enzyme system (followed as previously described[3] except that the concentration of H-donor was reduced to $M/250$) was almost unaffected by $M/100$ α-methyl-glucoside when glucose was used as H-donor, whilst with fructose, partial inhibition was obtained with 10^{-4} M α-methyl-glucoside.

These observations suggested that the action of α-methyl-glucoside was upon reactions leading to production by the cells of supplies of energy, rather than upon some reaction specific to the process of enzyme induction. An inhibitory action of α-methyl-glucoside upon carbohydrate metabolism (O_2 uptake) has actually been discovered several years ago by JOHNSON[4,5,6] who also found that on continued incubation there was, in general, a release from the inhibition ("escape phenomenon") at the lowest concentrations of inhibitor employed. We have repeated and confirmed this observation (at concs. of 10^{-4}–10^{-5} M glucoside). The inhibitory action was found for all sugars tested (at a conc. of $M/250$ sugar), with the exceptions of glucose, gluconate and xylose. However, when glucose was made available at very limited rates (by the action of a preparation of β-galactosidase on lactose[7]) to cells of a *galactose-negative* and *lactose-negative* mutant strain, similar phenomena could be observed with glucose as substrate. The available evidence, including some preliminary experiments with cell-free extracts, suggests that α-methyl-glucoside *may* be a competitive inhibitor of the phospho-fructokinase reaction, but further analysis of the site(s) of action of this inhibitor has been prevented by lack of suitable experimental material.

It seems possible that the mechanism of inhibition of enzymic adaptation by α-methyl-glucoside proposed above is also responsible for the inhibition of adaptation to maltose metabolism observed recently with *α-methyl-glucoside-negative* strains of yeast[8], rather than the postulated inhibition by a substrate analogue. Inhibitions of carbohydrate metabolism by α-methyl-glucoside similar to those reported by JOHNSON[4,5,6] have not only been found with *E. coli* (above) but also with strains of yeast capable of metabolising the glucoside[9,10].

REFERENCES

1 M. COHN AND J. MONOD, *Biochim. Biophys. Acta*, 7 (1952) 153.
2 M. R. POLLOCK AND S. D. WAINWRIGHT, *Brit. J. Exp. Path.*, 29 (1948) 223.
3 M. R. POLLOCK, *Brit. J. Exp. Path.*, 27 (1946) 419.
4 F. H. JOHNSON, *J. Cell. Comp. Phys.*, 8 (1936) 439.
5 F. H. JOHNSON, *J. Cell. Comp. Phys.*, 12 (1938) 281.
6 F. H. JOHNSON AND R. S. ANDERSON, *J. Cell. Comp. Phys.*, 12 (1938) 273.
7 F. JACOB, *Ann. Inst. Pasteur*, 82 (1952) 578.
8 S. HESTRIN AND C. C. LINDEGREN, *Arch. Biochem. Biophys.*, 38 (1952) 317.
9 J. LEIBOWITZ AND S. HESTRIN, *Biochem. J.*, 36 (1942) 772.
10 S. D. WAINWRIGHT, unpublished experiments.

Received March 6th, 1953

THE RELATION BETWEEN LIPID AND POLYSACCHARIDE CONTENTS OF *BACT. COLI*

by

S. DAGLEY AND A. R. JOHNSON

Department of Biochemistry, University of Leeds (England)

STEPHENSON AND WHETHAM[1] showed that the addition of acetate to an inorganic salt medium increased the lipid content of the *Timothy grass bacillus* but did not affect protein formation; glucose additions increased both protein and lipid contents, the former more than the latter. DAGLEY AND DAWES[2] demonstrated increased polysaccharide contents for *Bact. coli* when glucose and other sugars were added to the growth medium. We have estimated both lipid and polysaccharide in the same