

CYTOCHEMICAL LOCALIZATION OF GLUCOSE 6-PHOSPHATASE IN CILIATED CELLS OF RAT TRACHEAL EPITHELIUM

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The tracheobronchial epithelium is a ciliated epithelium. Its ciliary movement plays a role of cleaning the respiratory passage. For the ciliary movement, ciliated epithelial cells have probably large energy requirements and glucose from the blood is an important source of the energy. Therefore, it is of interest whether, or how, glucose 6-phosphatase (G-6-Pase), an important enzyme in glucose metabolism, is localized in the cells.

Female Sprague-Dawley rats, about 100 g, were used. They had free access to food and water prior to experiments. About 0.5 mm thick cross-sectioned tracheae adjacent to the bifurcation of the trachea were fixed in 2% glutaraldehyde buffered with 0.1 M cacodylate (pH 7) for 30 minutes at 4°C and washed in 0.1 M cacodylate (pH 7) for 1 hour at 4°C. The tissues were cut into 30 μ sections by a freezing microtome and incubated in Wachstein and Meisel's medium¹⁾ for the demonstration of G-6-Pase for 45 minutes at room temperature. The sections were postfixed in buffered 1% osmium tetroxide for 1 hour at 4°C, dehydrated in graded series of alcohol and embedded in Epon. Thin sections were cut with glass knives on a LKB ultratome, stained with uranyl acetate and lead citrate and examined in a JEM-7 A electron microscope. Control experiments were carried out as described previously.³⁾

The reaction product was present in the endoplasmic reticulum and nuclear envelope of ciliated cells, together with goblet cells. Golgi complex, mitochondria, plasma membrane and other organelles of these cells showed no deposits of final product. This pattern of localization is entirely equal to that of the enzyme in hepatocytes^{2,3)} and other cells, although new findings were expected because ciliated cells probably consume a large amount of glucose as a energy source of the ciliary movement.

G-6-Pase has an important role in carbohydrate metabolism. In the liver and kidney, gluconeogenesis and glycogenolysis are important pathways, and the role of G-6-Pase is to release glucose into the blood from these organs.^{4,5)} However, the physiologic function this enzyme is unknown in a variety of other organs. Arion *et al.*⁶⁾ have recently suggested that the physiologically functional form of this enzyme is specific for glucose 6-phosphate and hydrolysis of glucose 6-phosphate is the sole function of the enzyme in vivo. On the other hand, tracheal ciliated cells and goblet cells probably have large glucose 6-phosphate requirement as the energy

source for the ciliary movement and material for biosynthesis of secretory glycoprotein. Thus, these cells possibly have a potent ability to produce glucose 6-phosphate from glucose in the blood. One might, therefore, postulate that the role of G-6-Pase is to regulate the level of concentration of glucose 6-phosphate in these cells, hydrolyzing excess glucose 6-phosphate produced by these cells.

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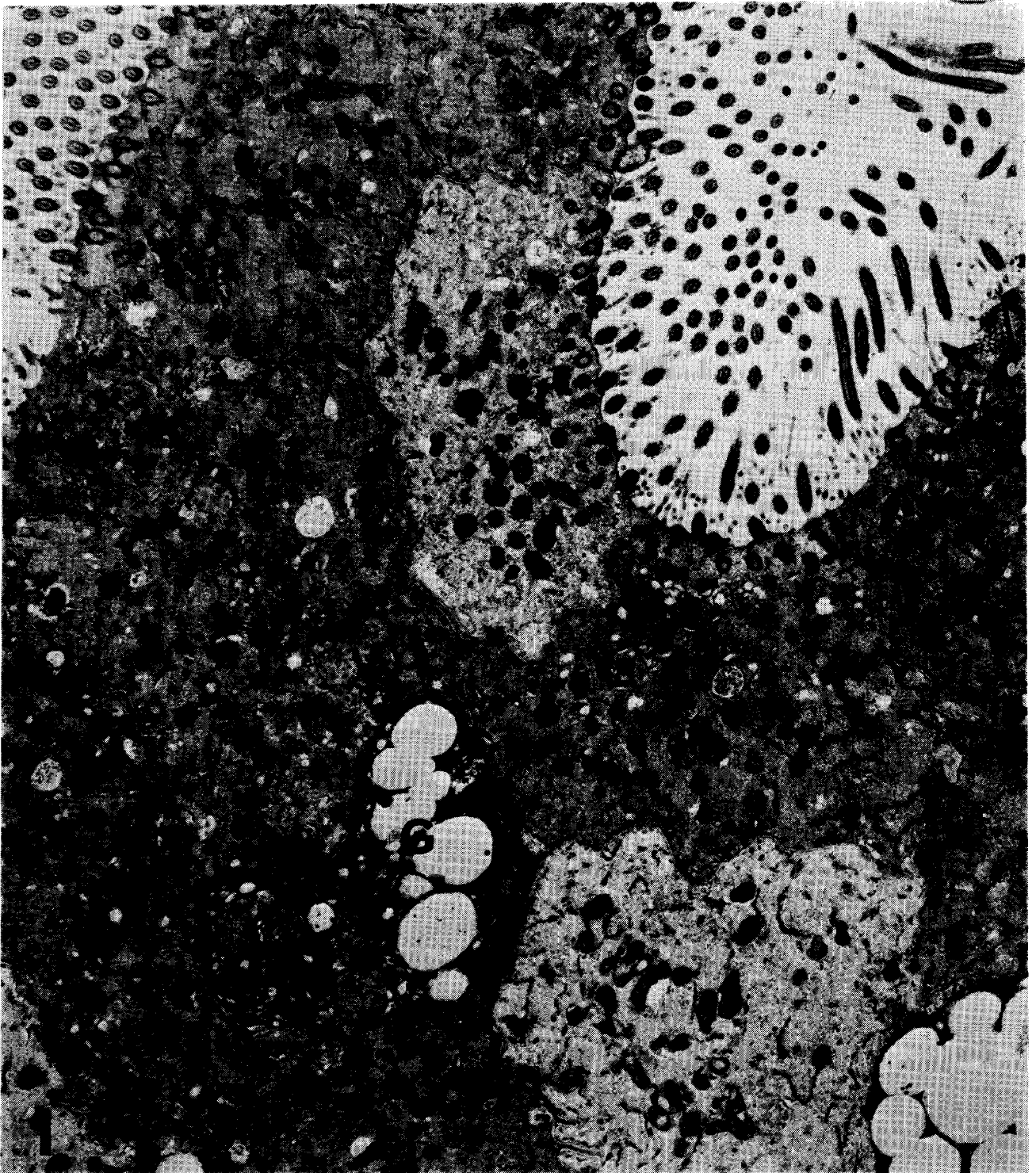


Fig. 1 An electron micrograph of the tracheal epithelium of rat showing the localization of G-6-Pase activity. The tissue were fixed with 2% glutaraldehyde at 4°C for 30 minutes cut at 30 μ and incubated in Wachstein and Meisel's medium. The reaction product is seen in the endoplasmic reticulum of ciliated cells and gobletcells (G). $\times 10,000$