The Inhibition of Systrophe by Cytochalasin B

Brief Report

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Summary

Cytochalasin B inhibits the phenomenon of the systrophe following plasmolysis.

Keywords: Cytochalasin B; Plasmolysis; Systrophe.

1. Introduction

Following plasmolysis in different salt solutions very often the formation of systrophe can be observed. It has been described as an active flowing together of the protoplasm and its components to form a cluster around the nucleus (KÜSTER 1910, 1929, GERM 1932, URL 1960). Other papers (WEIDINGER 1980 a, b, in press) show the electronmicroscopic aspect of the systrophe next to the cap-plasmolysis. In order to analyse this cytoplasmic movement further, the influence of cytochalasin B was investigated.

2. Materials and Methods

Fresh yellow onions (Allium cepa L.) grown in the botanical garden of the University of Bielefeld were used and epidermal cells from the inner surface of the third or fourth scale leaf were prepared according to the method of STRUGGER (1935). The plasmolytica were 0.6 M NaCl, 0.6 M KNO₃, 0.6 M KCl, 0.6 M KSCN respectively (pure chemicals of Merck). Cytochalasin B (Sigma Chemical Co.) was dissolved in dimethyl sulfoxide (DMSO) (Sigma Chemical Co.) and diluted in water to 10 µg/ml in 1% DMSO (SCHNEFF and von TRAITTEUR 1973), and also colchicine (Roth) was applied as a 0.5% solution. Epidermal cells were kept over night in H₂O dest., cytochalasin B solution, or in colchicine solution respectively. Then they were transferred to plasmolyticum or to such containing cytochalasin B or colchicine accordingly in the above mentioned concentrations. The photographs were taken about 3 hours later with an Olympus BHB microscope and an Agfapan 25 film.

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3. Results

The cells kept overnight in water or colchicin solution showed active cytoplasmic streaming the next day, whereas all those kept in cytochalasin B solution had stopped streaming. Put into plasmolyticum plasmolysis occurred in all cells evenly, independently of former treatment. After some time, however, cytoplasmic strands formed all through the control cells and through those treated with colchicin. Along these strands cytoplasm and organelles moved towards the nucleus. Nothing similar occurred in cells treated with cytochalasin B. After about 3 hours the appearance of the cells differed greatly according to treatment (Figs. 1-4). Plasmolysed control cells and such plasmolysed in the presence of colchicin showed perfect systrophes. All of the protoplasm had clustered around the nucleus. Systrophes were formed in NaCl as well as in KCl and KNO₃, but best in NaCl. About 10,000 cells were observed in each case. Apart from some dead cells and some that had formed cap-plasmolysis all cells (about 90%) showed perfect systrophes in 0.6 M NaCl (Fig. 1) and in 0.6 M NaCl containing colchicin (Fig. 2). On the contrary not one of the 10,000 cells plasmolysed in 0.6 M NaCl containing cytochalasin B showed such a systrophe. The cytoplasm and its components were dispersed randomly throughout the protoplast (Figs. 3 and 4). In 0.6 M KCl and in 0.6 M KNO₃ not quite as many cells formed systrophe in longer time. But in the same way no systrophes could be found in cells treated with cytochalasin B. More systrophes and a faster formation than in controls could be found in colchicin-treated tissues. Cells were also plasmolysed in 0.6 M NaCl containing DMSO only, without cytochalasin B. Systrophes were formed as in 0.6 M NaCl. Cap-plasmolysis was brought about by 0.6 M KSCN and no influence of either colchicin or cytochalasin B could be defined in this case. All effects were the same at several hours later observation.

4. Discussion

As generally assumed, microtubules and microfilaments are of great importance in many processes of motion (Hepler and Palevitz 1974). Therefore it seemed interesting to investigate, whether they might be in causal relationship also to the systrophe. By electron-microscope many microtubules

Fig. 1. Plasmolysis in 0.6 M NaCl. Perfect systrophes after 3 hours. Phase contrast. ×60
Fig. 2. Plasmolysis in 0.6 M NaCl + colchicin (0.5%). 3 hours. Perfect systrophes. Interference contrast (Nomarski). ×240
Fig. 3. Plasmolysis in 0.6 M NaCl + cytochalasin B (10 µg/ml in 1% DMSO). 3 hours. No systrophe. Phase contrast. ×60
Fig. 4. Plasmolysis in 0.6 M NaCl + cytochalasin B (10 µg/ml in 1% DMSO). 3 hours. Random dispersion of protoplasm. Interference contrast (Nomarski). ×240