Single cell mass analysis

U. Seydel, B. Lindner, K. Brandenburg

Borstel Research Institute, Dept. of Biophysics,
D-2061 Borstel, Germany (F.R.)

A newly developed microanalytical instrument, the laser microprobe mass analyser (LAMMA), is capable of tracing elements and molecules down to a detection limit of approximately 10^{-19}g (Na, K) in an analyzed mass of 10^{-13}g. We tested the possibility of applying the LAMMA-technique to single cell analysis. Positive results on the classification of different mycobacterial strains by fingerprinting /1/ and on the quantitative determination of the Na^+- and K^+-contents of single cells /2/ encouraged us to start experiments on detecting impairments in single bacterial cells induced either by thermal effects, radiation, or chemotherapy. Characteristic differences between the mass spectra of intact and impaired cells could be observed /3/.

In the present contribution we investigated the possibility of controlling the effectiveness of a chemotherapy by laser induced mass analysis of single bacterial cells. For this, two different mycobacterial strains (M.tuberculosis H 37 Ra, M.smegmatis SN2) were treated with isonicotinic acid hydrazide or ethambutol, respectively, added at the beginning of the exponential growth phase. One untreated culture, in each case was kept as a control.
At different times during growth samples were harvested, washed thoroughly, and spread on Formvar filmed Cu-grids. Mass spectra of 30 single cells of each sample were recorded, averaged and normalized. Characteristic differences in the spectra of the different samples become obvious. Thus, it may be concluded, that with this new technique a therapy control of diseases caused by bacteria not being cultivable in vitro (e.g. leprosy) might become possible.

/1/ Seydel, U. and Heinen, H.-J. (1980) in: Recent Developments in Mass Spectrometry in Biochemistry and Medicine, Vol. 6, eds. A. Frigerio and M. McCamish, Elsevier, Amsterdam, pp. 489-96
/2/ Seydel, U. and B. Lindner (1981) Int. J. Quantum Chem. (in press)
/3/ Seydel, U., Lindner, B., Seydel, J.K. and Brandenburg, K. (1981) Int. J. Leprosy (submitted)