Survivability of yeast in an electrodynamic balance

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Previous studies on survivability of microorganisms were mainly carried out by placing microbial-laden liquid, such as serum, on the surface. However, these viability test data could not reflect the survivability of microorganisms suspended in the air because the environmental stress levels would be different. Electrodynamic balance (EDB) has long been used to characterize the physical and chemical properties of single particle fixed and airborne in the chamber by electrostatic forces ((Sageev *et al.*, 1986). With the assistance of video capture and automatic feedback control system, the EDB became more advanced and versatile. In the present study, an EDB system was used, probably for the first time, to evaluate the survivability of yeast cell.

The experimental system, as shown in Figure 1, consisted of (1) a double-ring EDB chamber which was designed to levitate one particle with DC and AC field, (2) a laser beam (I= 0~100 mW, λ= 532nm) to illuminate particle, and a digital camera (400X) to capture image of the target particle, and (3) an automatic control system written in Labview 8.2. Before introducing bioaerosol to EDB, the system was tested and optimized by using monodisperse (5, 10, 15 μm) acrylic powders. The operating DC and AC voltages were 200~1000 V and 1.3 kV/frequency= 350~1000 Hz, respectively. Yeast cell (Saccharomyces cerevisiae YPH499) was chosen for its size, falling right into the working range of EDB (3 to tens μm). The yeast aerosols were generated by using a Wright nozzle modified for maximum aerosol output. A retrieving probe was made to capture the yeast cell levitated in the EDB. The retrieved cell was then cultivated to examine the viability. Laser light intensity, chamber temperature, humidity, and retention time in the chamber are among the principal operating parameters.

The results showed that the EDB system could retain super-micrometer-sized (5, 10, 15 μm) acrylic powders and yeast aerosols in the chamber for hours or even days. The survival rate of yeast cells was around 5%, after retrieved from the EDB chamber with RH= 20% and then cultivated on YEPD agar. The survival rate increased (from 5 to 26%) with increasing relative humidity (from 20 to 75%) in the EDB chamber. The survival rate decreased with increasing retention in the chamber, for example, from 28% of 5 min down to 22% of 30 min. These survival rates are much lower than yeast cells in distilled water before aerosolization (90%) and yeast cells after aerosolization (80%). However, it should be noticed that both high survival rates were based on viability test following methylene blue staining procedure, which might not be exactly the same with YEPD agar cultivation method.

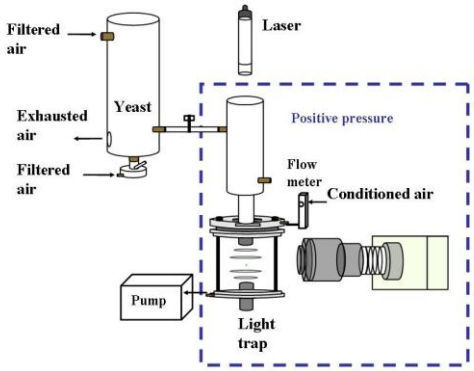

Figure 1. Schematic diagram of the electrodynamic balance system

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Sageev, G., J. H. Seinfeld and R. C. Flagan (1986). "Particle sizing in the electrodynamic balance." Review of Scientific Instruments 57(5): 933-936.