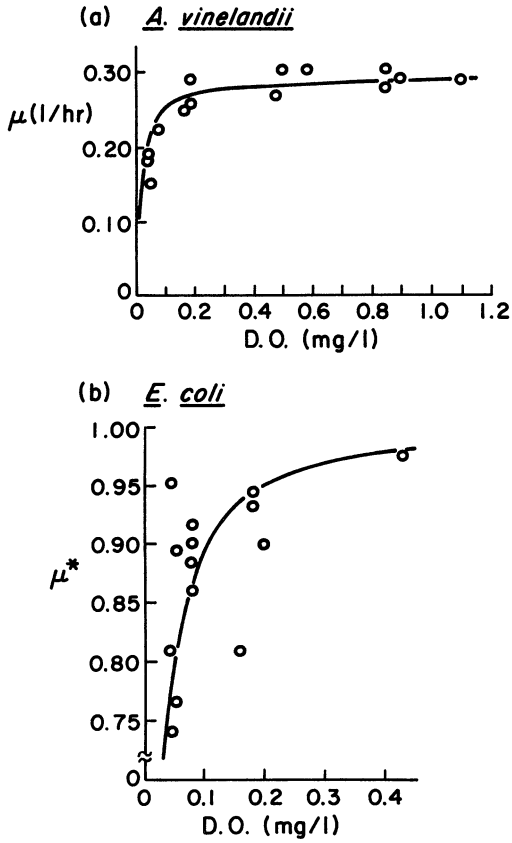

Figure 6.9. Growth-rate dependence on DO for (a) *Azotobacter vinelandii*, a strictly aerobic organism, and (b) *E. coli*, which is faculative. *E. coli* grows anaerobically at a rate of about 70% of its aerobic growth in minimal medium.

$$\mu^* = \frac{\mu - \mu_m^{\text{anaerobic}}}{\mu_m^{\text{aerobic}} - \mu_m^{\text{anaerobic}}}$$

(With permission, from J. Chen, A. L. Tannahill, and M. L. Shuler, *Biotechnol. Bioeng. 27*: 151, 1985, and John Wiley & Sons, Inc., New York.)

concentration (mg/l), C_L is the actual DO concentration in the broth (mg/l), and the N_{O_2} is the rate of oxygen transfer (mg O_2/l·h). Also, the term *oxygen transfer rate* (OTR) is used.

The rate of oxygen uptake is denoted as *OUR* (*oxygen uptake rate*) and

$$\text{OUR} = q_{O_2} X = \frac{\mu_g X}{Y_{X/O_2}} \tag{6.22}$$

where q_{O_2} is the specific rate of oxygen consumption (mg O_2/g dw cells·h), Y_{X/O_2} is the yield coefficient on oxygen (g dw cells/g O_2), and X is cell concentration (g dw cells/l).

When oxygen transfer is the rate-limiting step, the rate of oxygen consumption is equal to the rate of oxygen transfer. If the maintenance requirement of O_2 is negligible compared to growth, then

$$\frac{\mu_g X}{Y_{X/O_2}} = k_L a(C^* - C_L) \tag{6.23}$$

or

$$\frac{dX}{dt} = Y_{X/O_2} k_L a(C^* - C_L) \tag{6.24}$$