CLOSE

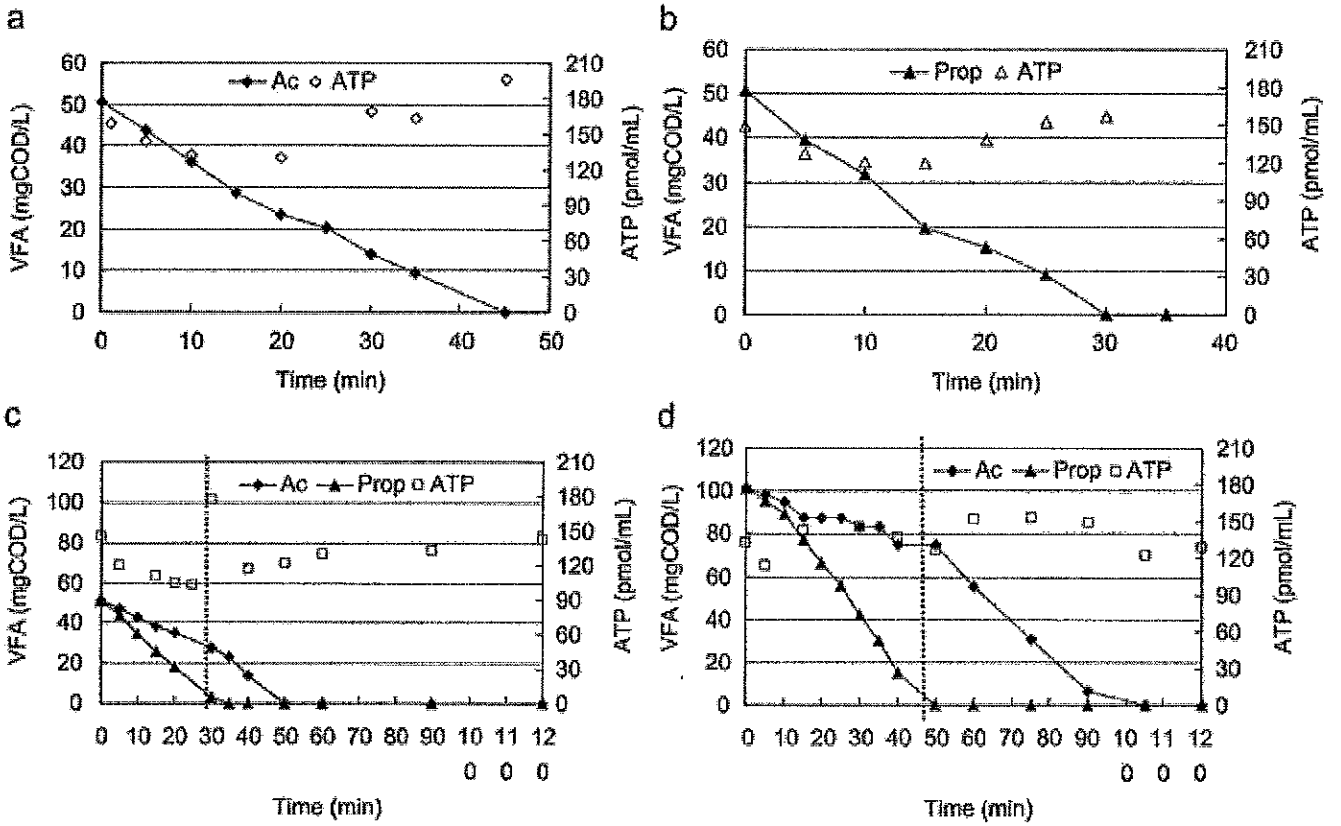

Fig. 6. Variation of the intracellular ATP concentration during anaerobic uptake of acetate and propionate as single and dual carbon sources (Ac, acetate; Prop, propionate).

3.5 Voltage generation by fermentative bacteria?

Bacteria that produce energy from substrate fermentation obtain energy by substrate level phosphorylation, taking a substrate (such as glucose) and producing a variety of different end products (Fig. 3.3). When a microbe makes acetate, it can produce the most ATP from fermentation. However, it also produces NADH which must be converted back to NAD^+ to sustain the reaction. One possible way for cells to regenerate NAD^+ from NADH is using a reversible hydrogenase that produces hydrogen. Let us compare the potential of the $NADH/NAD^+$ couple to that of the hydrogen couple ($2H^+/H_2$) under the same conditions (pH = 7), where the hydrogen couple has a potential of $E_0' = -0.421$ V. Thus, under these "standard conditions" (1 M concentration of each soluble species, and 1 bar pressure for H_2), NADH cannot transfer these electrons through a hydrogenase to form H_2 as the process is thermodynamically unfavorable ($E = -0.421$ V $- (-0.320$ V) = -0.09 V). However, as indicated above the relative concentrations of $NADH/NAD^+$ can vary within the cell, allowing the potential to change.

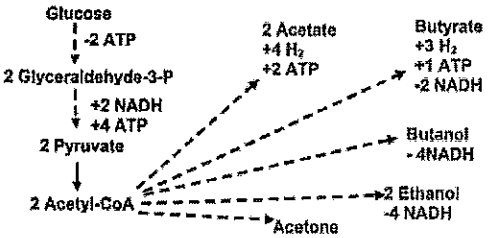

Fig. 3.3 Different fermentation pathways used by *Clostridium acetobutylicum* (ATCC 824) to generate ATP or regenerate NADH (*Girbal et al.* 1995).