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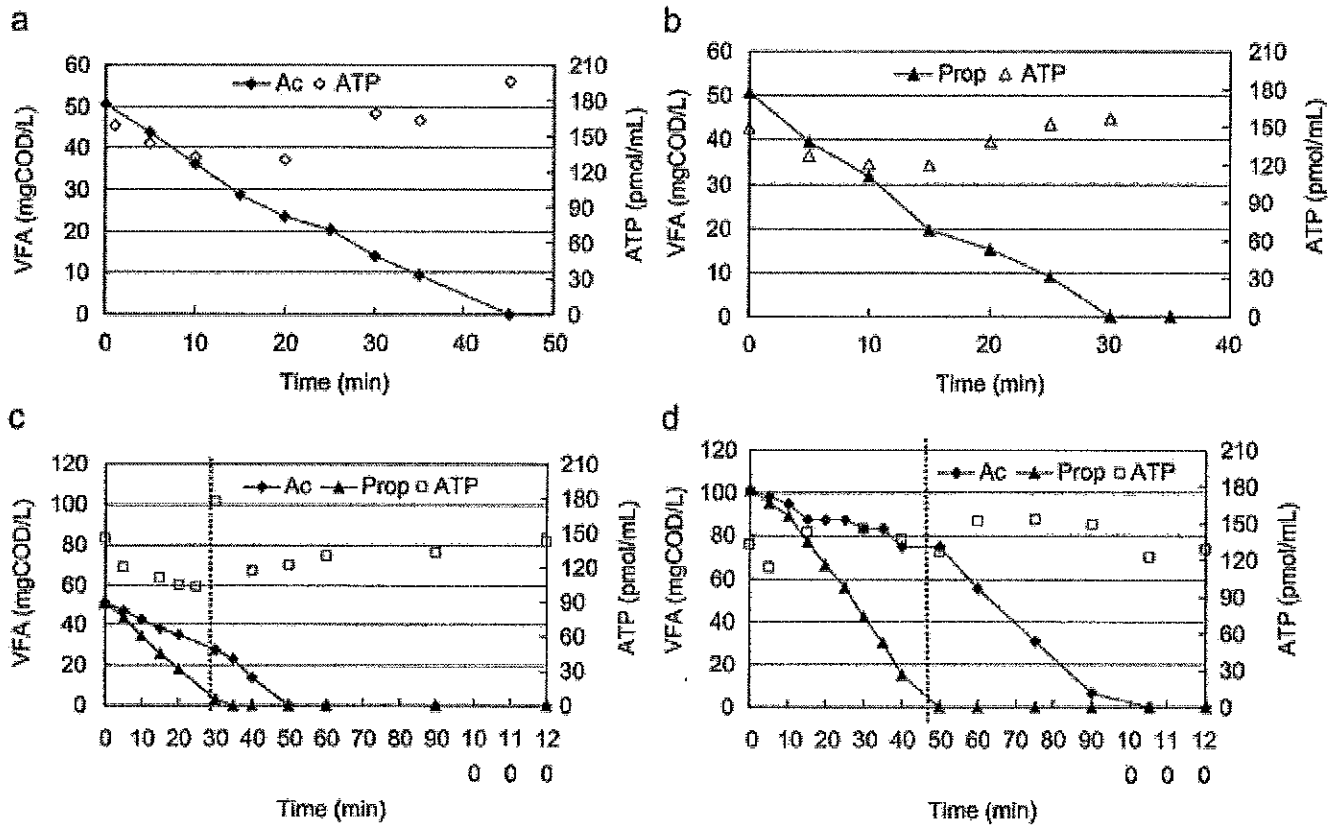


Fig. 6. Variation of the intracellular ATP concentration during anaerobic uptake of acetate and propionate as single and dual carbon sources (Ac, acetate; Prop, propionate).

Microbial fuel cells By Bruce E. Logan

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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⁺/H₂) 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 H₂), NADH cannot transfer these electrons through a hydrogenase to form H₂ 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.

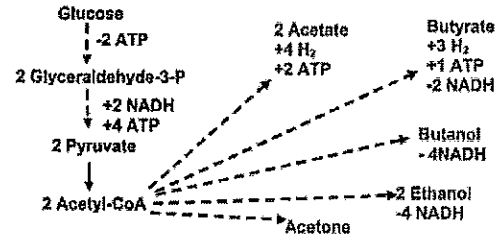


Fig. 3.3 Different fermentation pathways used by *Clostridium acetobutylicum* (ATCC 824) to generate ATP or regenerate NADH (Gibbal et al. 1995).