**Fig. S2.** Pathway for fermentation of glucose to butyrate and acetate. (A) Typical pathway, which does not involve Ech. (B) Atypical pathway, which involves Ech and found in some rumen bacteria (*Butyrivibrio hungatei* JK615, *Butyrivibrio proteoclasticus* B316, *Pseudobutyrivibrio xylanivorans* Mz 5). The coefficient $x$ is the number of acetate formed (consumed) and varies by bacterium (see Supporting Information Table S2). It is assumed that another reaction (e.g., that catalyzed by an antiporter) balances $\text{Na}^+$ and $\text{H}^+$. Panel A is adapted from Louis and Flint (2017), and panel B is adapted from Hackmann and Firkins (2015). Panel A includes reactions shown in Supporting Information Fig. S1A, E, J, L, U, X, Y, AD, AE, AF, AY, BC, and BD. Panel B includes reactions shown in Supporting Information Fig. S1A, E, J, L, U, X, Y, AD, AE, AF, BB, BC, and BD. Reactions: 1. pyruvate:ferredoxin oxidoreductase; 2. acetyl-CoA C-acetyltransferase; 3. 3-hydroxybutyryl-CoA dehydrogenase; 4. enoyl-CoA hydratase; 5. butyryl-CoA dehydrogenase; 6. ferredoxin hydrogenase, cytoplasmic; 7. Rnf; 8. ATP synthase; 9. Ech hydrogenase. Abbreviations: $\text{Fd}_{\text{ox}} = \text{oxidized ferredoxin}$, $\text{Fd}_{\text{red}} = \text{reduced ferredoxin}$, $\text{NAD}_{\text{ox}} = \text{oxidized NAD}$, and $\text{NAD}_{\text{red}} = \text{reduced NAD}$. 
Figure S2

(A)
Figure S2

(B)

1 Glucose

2 ADP + 2 P₁ + 2 NAD_{ox} → 2 H₂O
2 ATP + 2 NAD_{red} → 2 Pyruvate
2 Fd_{ox} → 2 CoA
2 Fd_{red} → 2 CO₂

(2 - x) Acetyl-CoA → x Acetyl-CoA
x ADP + x P₁ → (1 + x/2) CoA → x ATP → x CoA
(1 - x'/2) Acetoacetyl-CoA → x Acetate

(1 - x/2) NAD_{red} → (1 - x/2) NAD_{ox}
(1 - x/2) (S)-3-Hydroxybutanoyl-CoA

(1 - x/2) Fd_{ox} + 2 NAD_{red} → (1 - x/2) Butanoyl-CoA
(1 - x/2) (ADP + Pᵢ) → (1 - x/2) ATP → (1 - x/2) CoA
(1 - x/2) Butyrate

(2 + x) Fd_{red} → (4 + 2x) H⁺
(2 + x) Fd_{ox} → (2 + x) H₂
(4 + 2x) H⁺ → (2 + x) H₂

(1 - 3/2 x) Fd_{red} + NAD_{ox} → (2 - 3x) Na⁺
(1 - 3/2 x) Fd_{ox} + NAD_{red} → (2 - 3x) Na⁺

(6 - x)/4 × (ADP + Pᵢ) → (6 - x) H⁺
(6 - x)/4 × (ATP + H₂O) → (6 - x) H⁺