Electrical current is more than hydrogen during microbial electrosynthesis and electrofermentation

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Electricity is being used to drive microbial and enzymatic reactions. This is mostly done on the basis of setting an electrode potential and thus facilitating a certain redox reaction. Applying a fixed current has several implications in bioelectrochemistry besides delivering or withdrawing reducing equivalents at a fixed rate. During microbial electrosynthesis, a microbial reduction reaction is driven at the cathode, for example CO_2 fixation into volatile fatty acids (VFA) or glycerol conversion into 1,3-propanediol (1,3PDO). Driving these reactions by means of an electrical current enables chain elongation of VFA's, and production of alcohols at higher rates compared to addition of H_2 gas. The pH decreases due to the activity of the microorganisms at the cathode, especially during fermentation of heterotrophic substrates. By balancing the current with the rate of microbial fermentation, base dosing can be lowered or even avoided due to the creation of base at a fixed rate at the cathode based on water electrolysis. A third benefit of current over hydrogen gas is based on charge movement in an electrochemical cell. Charge balancing is usually achieve by the movement of small (in)organic ions. However, by making use of selective membranes and an electrical current, extraction of specific charged compounds (for example VFAs or NH_4^+) can be achieved. Thus creating a pure product stream separated from the microbial broth. In conclusion, electrical current is and can do more than just delivering reducing equivalents for a bioelectrochemical reaction.