Figure 2 - figure supplement 1

A

$$nH^{+}_{out} + mPep_{out} \rightleftharpoons nH^{+}_{in} + mPep_{in}$$

B

$$\mu_{Hout} = \mu^{\circ}_{H} + RT\ln[H]_{out} + z_H F\Psi_{out}$$

etc.

$$\Delta\mu_H = \mu_{Hin} - \mu_{Hout}$$

$$\Delta\mu_H = RT\ln\frac{[H_{in}]}{[H_{out}]} + zF\Delta\Psi$$

$$E_H = -\frac{RT}{z_H F}\ln\frac{[H_{in}]}{[H_{out}]}, z_H = +1$$

$$\Delta\mu_H = -FE_H + F\Delta\Psi$$

$$\Delta\mu_{pep} = RT\ln\frac{[Pep_{in}]}{[Pep_{out}]}$$

C

$$\sum n_i\mu = 0$$

$$n\mu_{Hin} + m\mu_{pepin} - n\mu_{Hout} - m\mu_{pepout} = 0 = n\Delta\mu_H + m\Delta\mu_{pep}$$

D

$$0 = nRT\ln\frac{[H]_{in}}{[H]_{out}} + z_{H^+}nF\Delta\Psi + mRT\ln\frac{[Pep]_{in}}{[Pep]_{out}}$$

$$-\frac{nF}{2.303RT}\Delta\Psi = n\log\frac{[H]_{in}}{[H]_{out}} + mRT\log\frac{[Pep]_{in}}{[Pep]_{out}}$$

$$\frac{2.303RT}{F} \approx 60mV, pH = -\log[H]$$

$$-\frac{n\Delta\Psi}{60mV} = n[-pH_{in} - (-pH_{out})] + m\log\frac{[Pep]_{in}}{[Pep]_{out}}$$

$$-\frac{n\Delta\Psi}{60mV} = n[pH_{out} - pH_{in}] + m\log\frac{[Pep]_{in}}{[Pep]_{out}}$$

$$\Delta\Psi = 60\left\{[pH_{in} - pH_{out}] - \frac{m}{n}\log\frac{[Pep]_{in}}{[Pep]_{out}}\right\}$$