

estimating the number of proteins per cell volume

protein mass per volume ($\approx 0.2 \text{ g/ml}$)

number of proteins per cell volume $\left\{ \frac{N}{V} = \frac{c_p}{l_{aa} \times m_{aa}} \right.$ ← mass aa ($\approx 110 \text{ Da}$)

aa per protein ($\approx 350 \frac{\text{aa}}{\text{protein}}$)

Avogadro's number

$$\frac{N}{V} = \frac{0.2 \text{ [g/ml]} \times 6 \times 10^{23} \left[\frac{\text{Da}}{\text{g}} \right] \times 10^{-12} \left[\frac{\text{ml}}{\mu\text{m}^3} \right]}{350 \left[\frac{\text{aa}}{\text{protein}} \right] \times 110 \left[\frac{\text{Da}}{\text{aa}} \right]} \approx 3 \times 10^6 \frac{\text{proteins}}{\mu\text{m}^3}$$

organism	characteristic volume	number of proteins
<i>E. coli</i>	$\approx 1 \mu\text{m}^3$	$\approx 3 \times 10^6$
budding yeast	$\approx 30 \mu\text{m}^3$	$\approx 100 \times 10^6$
HeLa cell line	$\approx 3,000 \mu\text{m}^3$	$\approx 10 \times 10^9$

Figure 1. A back of the envelope calculation of the number of proteins per cell volume. Application for selected model organisms based on their characteristic cell volumes is also given. Estimate is based on generic parameter values. For more accurate organism specific values see main text.