

Permeability of red blood cells

BIO1540 Section B6

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Table 1. Observed permeability of red blood cells in varied solutions. Hemolysis times are in seconds for the five solutions tested in the lab and sample sizes (N) are in parenthesis.

Solutions	Hemolysis times	
	AV ^a	SE ^b
bidistilled water	2 ^c (3)	0
glycerol (0.3 M)	947(3)	7
ethylene glycol	9(3)	0.6
sucrose (0.3 M)	1200 ^d (3)	0
urea (0.3 M)	2 ^c (3)	0

^aAV stands for mean average

^bSE stands for standard error

^cif hemolysis occurs instantaneously, 2 was used in the calculations

^dif hemolysis does not occur after 20 minutes, 1200 was used in calculations

Questions:

1- What are the factors that affect the diffusion of the solutes tested in the permeability experiment?

The factors that affect the diffusion of the solutes tested in the permeability experiment are the size and polarity of the molecules.

2- How do these factors affect the diffusion of solutes?

Water and urea are small polar molecules and so they can diffuse readily through the phospholipid bilayer. Polar molecules can usually not diffuse through the phospholipid bilayer because they stick to the hydrophilic heads of the phospholipids and are repelled by the hydrophobic tails. However, due to water's and urea's small size, they can easily pass through the membrane. This is illustrated in the permeability experiment as it took less than two seconds for hemolysis to occur with both water and urea.

Ethylene glycol is also a small polar molecule and so it can diffuse easily across the cell membrane. Even though ethylene glycol is polar, it can still diffuse across the phospholipid bilayer because of its small size. Our results back up the theory since it took, on average, nine seconds for hemolysis to occur.

Glycerol is a bit bigger than ethylene glycol and is a polar molecule so it takes a long time for it to diffuse across the phospholipid bilayer. Glycerol has three hydroxyl groups which causes the molecule to get stuck frequently in the phospholipid bilayer. This is why red blood cells have carrier proteins to transport polar molecules such as glycerol into the cell by facilitated diffusion. The problem with facilitated diffusion is that it has a maximum speed whereas simple diffusion does not. The theory agrees with our results since hemolysis took a long time to occur with glycerol in our experiment.

Sucrose is a large polar molecule, and consequently, it cannot pass readily through the cell membrane. Sucrose molecules are too large to move through the cell membrane by themselves since they get caught in the hydrophilic heads of the phospholipid bilayer. In effect, sucrose molecules must enter the cell by facilitated diffusion. Facilitated diffusion is slower than simple diffusion and so it is logical that hemolysis took a long time to occur with sucrose in our experiment.