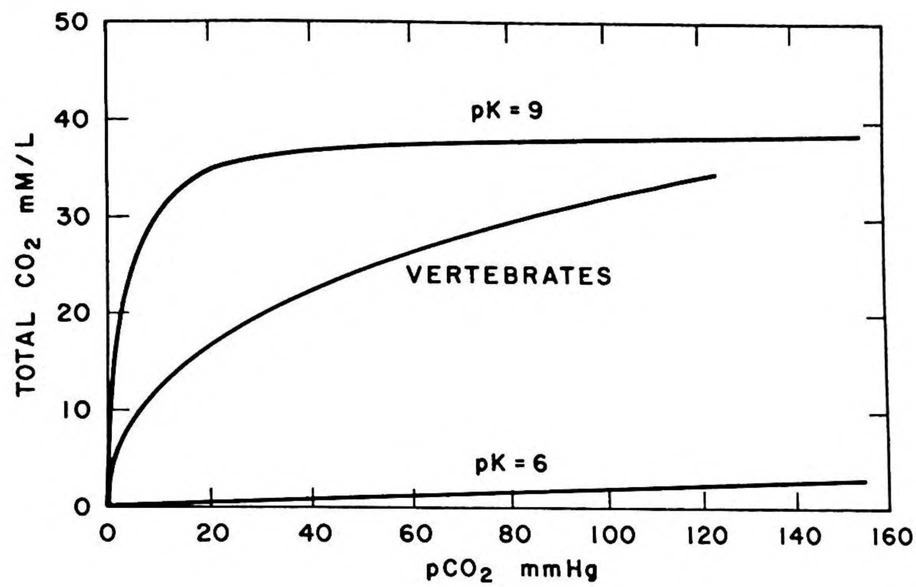

Figure 1

The major compounds with appropriate pK values for subserving CO_2 exchange are proteins containing substantial imidazole residues and $_\alpha$amino groups. Presumably the similarity of CO_2 titration curves among vertebrates reflects a similar protein pattern. Solutions containing substantial concentrations of buffers with pK ~ 7.0 will have a pH around this value. It may be concluded that the fact that vertebrate extracellular and intracellular pH values are generally in the range pH = 7, reflects the operation of the above factors.

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ENERGY METABOLISM IN THE ERYTHROCYTES OF THE HARBOR SEAL (Phoca vitulina)

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The erythrocytes of a number of mammalian species (seal, cat, dog) show relatively high intracellular Na^+ and relatively low intracellular K^+ concentrations. The intracellular-extracellular concentration ratios are substantially closer to electro-chemical equilibrium than is true of human, rat, and rabbit erythrocytes. The major source of energy in the mature mammalian erythrocyte is anaerobic glycolysis. Further, calculations of the minimum work required for the active transport of Na^+ and K^+ in low Na^+ cells suggest that a substantial fraction of total energy must be devoted to the work of active cation transport. It seemed of interest to investigate the rate of anaerobic glycolysis; the stoichiometry of glucose to lactate conversion; and the effect of ouabain on glycolytic rate in the high Na^+, low energy requiring erythrocyte of the harbor seal.

Blood was obtained from the extra dural vein of the animal. Erythrocytes were separated by centrifugation and washed 3 times in seal-Ringers containing 5 mM glucose. The red cells were then suspended in seal-Ringers glucose and incubated for 4 hours at 40°C. Glucose consumption and lactate production were measured by the changes in substrate concentrations of

Table 1

BASAL RATE OF LACTATE PRODUCTION AND EFFECT OF 10^{-4}M OUABAIN IN HIGH Na^+ SEAL ERYTHROCYTE AND LOW NA^+ HUMAN ERYTHROCYTE

Seal erythrocytes Q Lactate mM/L/hr		Human erythrocytes Q Lactate mM/L/hr	
Control	Ouabain 10^{-4}M	Control	Ouabain 10^{-4}M
2.30	2.50	1.98	1.74
2.76	2.60	2.10	1.80
2.58	2.50	1.94	1.40
2.09	2.68	2.65	2.32
2.47	2.24	2.70	2.14
2.21	1.90	2.63	2.53
2.78	2.27	2.85	2.46
Mean 2.46 ± 0.24 (S.D.)	2.39 ± 0.29 (S.D.)	2.41 ± 0.42	2.06 ± 0.42
"p" Not significant		$p < 0.001$	

Table 2

STOICHIOMETRY OF GLUCOSE CONVERSION TO LACTATE IN HIGH Na^+ SEAL RED CELLS VERSUS LOW Na^+ HUMAN RED CELLS

	Q glucose mM/L/hour	Q lactate mM/L/hour	Q lactate/Q glucose
Seal (7)	1.59 ± 0.50	2.67 ± 0.34	1.82 ± 0.61
Human (11)	1.18 ± 0.20	2.03 ± 0.45	1.75 ± 0.22

( ) = Number of studies.

the cell mixture using a cell to Ringers ratio of 20%. Lactate was measured enzymatically using LDH and glucose measured enzymatically using glucose oxidose. Studies were performed under control circumstances and on cells exposed to 10^{-4}M ouabain octahydrate. For comparison, similar studies were performed on low Na^+ (high energy requiring) human erythrocytes. The results are summarized in the tables.

The following may be concluded:

1. The basal metabolic rate of human and seal erythrocytes is essentially the same despite the substantially greater energy requirements for cation transport in human red cells.

2. The stoichiometry of glucose conversion to lactate is similar in both types of cells.

3. The lowered requirement for energy in the seal erythrocyte is not met by a corresponding decrease in metabolic rate nor is there a clear alteration of glycolytic pathways so that more glucose is metabolized to 2-3 diphosphoglyceric acid and less blucose follows the normal glycolytic pathway.

4. Studies of heat production in the 2 types of cells would be of great interest since excess energy in the seal erythrocyte could conceivably be dissipated as heat.