

Buffer

is a substance with the capacity to bind or release H^+ and thus minimise changes in pH.
 consist of a mixture of a weak acid and its conjugate base
 is most effective when pH equals its pKa, at which it is 50% ionised
 effectiveness in a physiological system is also dependent on if it is open
 eg bicarbonate system where CO_2 may be removed via the lungs

Body compartments

In the ECF the target pH is 7.4 (RBCs are usually considered in the ECF category)
 In the ICF the target pH is 6.8

CO₂-bicarbonate buffer system

major buffer system in the ECF
 80% of extracellular buffering.
 most important for metabolic acids
 cant buffer resp acid-base disorders.

components are related by the
 Henderson-Hasselbalch equation.
 $pH = pK'a + \log_{10}([HCO_3^-]/0.03 \times pCO_2)$

pK'a value is dependent
 temperature,
 [H+]
 ionic concentration

pKa 6.1 at pH 7.4 and 37 C

although 6.1 not close to 7.4, system
 is open at both ends, HCO_3^- and CO_2
 removed at kidney and lungs greatly
 increases the buffering effectiveness
 of this system.

the excretion of CO_2 via the lungs is
 particularly important because of the
 rapidity of the response. The adjust-
 ment of pCO_2 by change in alveolar
 ventilation has been referred to as
 physiological buffering.

Protein buffering

Protein buffers in blood include
 haemoglobin (150g/l) and plasma
 proteins (70g/l).

buffering is by the imidazole group of
 the histidine residues which has a pKa
 of about 6.8.

this is suitable for effective buffering
 at physiological pH.

Haemoglobin is quantitatively about
 6 times more important than the
 plasma proteins as it is present in
 about twice the concentration and
 contains about three times the
 number of histidine residues per
 molecule.

The solubility of CO_2 and the action of
 carbonic anhydrase make Hb proteins
 very effective at buffering

DeoxyHb works better than OxyHb
 because the imidazole groups pKa
 when reduced is 7.9. This is advanta-
 geous physiologically because the
 CO_2 is higher in deoxy blood.

Phosphate buffering

The phosphate system HPO_4^{2-} and
 $H_2PO_4^-$ has a pKa of 6.8 and so has a
 theoretic advantage over bicarbonate.
 It only exists in very small concentra-
 tion in the ECF however and is a
 closed system so makes minimal
 contribution. It is however a signifi-
 cant buffer in the ICF.