IRCS Medical Science: Biochemistry; Cell and Membrane Biology; Hematology; Physiology, **8**, 610 (1980)

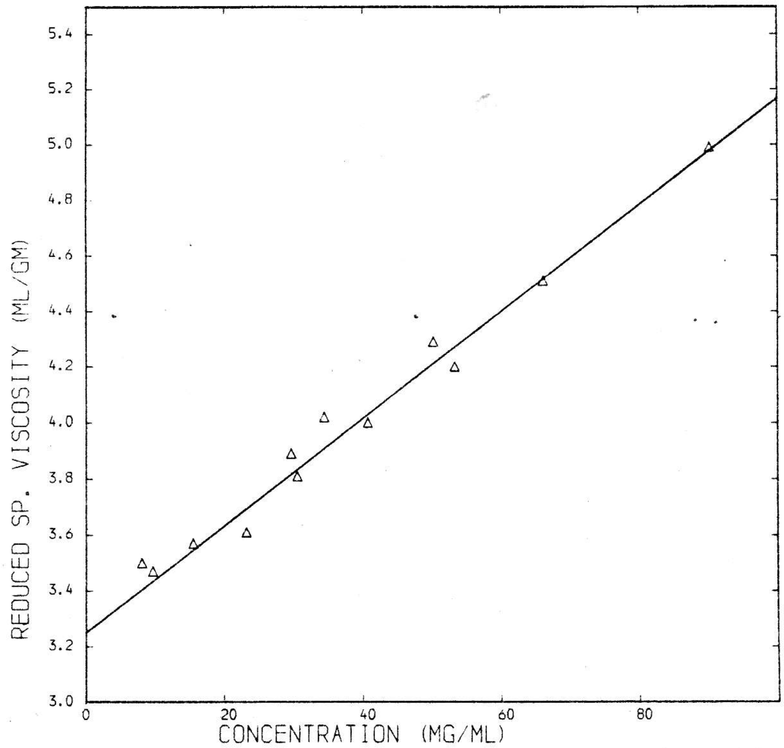
VISCOSITY PARAMETERS FOR MYOGLOBIN

Stephen E. Harding

Department of Biochemistry, University of Leicester, Adrian Building, University Road, Leicester LE1 7RH, England

Paper received: 30th June, 1980; amended 26th July, 1980

Myoglobin is present in muscle tissue of mammals, serving as a reserve supply of oxygen and also facilitating the movement of oxygen within the muscle. An understanding of its viscous flow properties in solution is therefore of physiological importance; viscosity parameters can also give valuable information about the gross conformation and swollen volume of the protein in solution. In this study the viscous flow properties of myoglobin from sperm whale was investigated in 0.1M NaCl buffer, pH = 7.1. A capillary viscometer was used and the reduced viscosities, η_{red} determined in the usual way (1). The concentrations, c, were determined using a precision density meter (2) and a partial specific volume, $\bar{v}$ of 0.741 ml/g (3). The straight line fitted to the data (figure) is that using a weighted least squares analysis to $\eta_{red} = [\eta](1 + k_\eta c)$. The intrinsic viscosity, $[\eta]$, was found to be 3.25 (± 0.05) ml/g, and the regression coefficient, k_η to be 5.9 (± 0.1) ml/g.



Plot of reduced specific viscosity versus concentration for sperm whale myoglobin (0.1 M NaCl buffer, pH = 7.1). Weight used for the straight line fit: 1/c (mg/ml) for c ≤ 40 mg/ml; 1/40 for c > 40 mg/ml.

Myoglobin in the crystalline state has dimensions of approximately 43 X 35 X 23 Å (4) corresponding to a general tri-axial ellipsoid of semi-axes a > b > c with axial ratios a/b = 1.23, b/c = 1.52. This corresponds to a viscosity increment ν of 2.729 (5, 6). The predicted intrinsic viscosity can be found using a relation given by Rowe (7): $\nu = [\eta]/\bar{v}_s = ([\eta]/\bar{v})(\bar{v}/\bar{v}_s)$ where $\bar{v}_s$ is the swollen specific volume. In order therefore for the predicted $[\eta]$ to equal the experimental value of 3.25, the 'swelling', $\bar{v}_s/\bar{v}$ must be as high as 1.6, i.e. a 60% swelling (v/v) in solution; alternatively myoglobin in solution is more asymmetric than in the crystalline state. In order however to determine the actual dimensions of the equivalent tri-axial ellipsoid for myoglobin in solution, without assumptions concerning the hydrodynamic volume, it is necessary to combine results from viscosity, sedimentation and electric birefringence.

1. Yang, J.T. (1961) *Adv. Protein Chem.*, 16, 323-400
2. Kratky, O., Leopold, H. and Stabinger, H. (1969) *Z. Angew. Phys.*, 27, 273
3. Theorell, H. (1934) *Biochem. Z.*, 268, 46
4. Kendrew, J.C., *et al.*, (1958) *Nature*, 181, 663-666
5. Harding, S.E., Sampier, M. and Rowe, A.J. (1979) *IRCS Med. Sci.*, 7, 33
6. Harding, S.E. Dampier, M. and Rowe, A.J. (1979) *J. Coll. Int. Sci.*, (in press).
7. Rowe, A.J. (1977) *Biopolymers*, 16, 2595-2611