

A NOTE ON THE CELL WATER DENSITY IN AMPHIBIAN EGGS

BY KJELL HANSSON MILD* AND SØREN LØVTRUP

Department of Zoophysiology, Umeå University, S-901 87 UMEÅ, Sweden

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In a recent publication of ours on cell water density in amphibian eggs (Hansson Mild, Løvtrup & Forslind, 1979), the relation between the egg density, ρ , and the water content was established experimentally. It was then assumed that ρ could be theoretically related to the cell water density, ρ_w , and the density of the solids in the cell, ρ_s , on a weight average basis (equation (10) in Hansson Mild *et al.* 1979). However, this assumption is not correct, a fact which has been brought to our attention by Drs W. Drost-Hansen and J. Clegg (personal communication, 1980). Instead the egg density should be related to ρ_w and ρ_s on the basis of volume fractions as derived below.

The egg density can be expressed as

$$\rho = \frac{dw + m}{V_{dw} + V_w} = \frac{M}{V_{dw} + V_w}, \quad (1)$$

where dw is the mass of the solids and m of the water, V_{dw} and V_w are the corresponding volumes. Equation (1) can be rearranged into

$$\rho = \frac{\rho_s}{1 + X \left(\frac{\rho_s}{\rho_w} - 1 \right)} \quad (2)$$

where $X = m/M$, $\rho_s = dw/V_{dw}$, and $\rho_w = m/V_w$. This equation should be compared with the experimentally determined relation between ρ and X , given by equation (12) in Hansson Mild *et al.* (1979),

$$\rho = 1.208 - 0.193 X. \quad (3)$$

Equation (2) is nonlinear in X and a comparison with the experimentally determined values therefore is not straightforward. One may make a Taylor expansion to the first order of equation (2) near $X = 0.5$, but as the coefficients of this equation become functions of ρ_s and ρ_w , the error in the calculated densities becomes large. A more accurate method makes use of the fact that equation (2) can be rearranged to give the inverse of the egg density as a linear function of the water content of the egg,

$$\frac{1}{\rho} = \frac{1}{\rho_s} + X \left(\frac{1}{\rho_w} - \frac{1}{\rho_s} \right). \quad (4)$$

* Present address: National Board of Occupational Safety and Health, Department of Occupational Health, S-901 85 UMEÅ, Sweden.

The original data which gave equation (3) can also be represented by a straight line with the inverse egg density as a function of X . This is possible due to the relative narrow range over which the water content of egg cell varies in these experiments. From the experimental data of Hansson Mild *et al.* (1979), this new approach then, gives,

$$\frac{1}{\rho} = 0.821 + 0.159X. \quad (5)$$

Equations (4) and (5) now give $\rho_s = 1.218$ and $\rho_w = 1.020$ g/cm³, values which are slightly higher than the ones obtained previously.

In our earlier publication it was concluded that cell water has a density slightly but significantly above that of ordinary water, a circumstance which we referred to the likely structuration of the water bound to various subcellular structures. The corrected value presented here further strengthens this conclusion.

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REFERENCE

- HANSSON MILD, K., LØVTRUP, S. & FORSLIND, E. (1979). High density cell water in amphibian eggs? *J. Exp. Biol.* **83**, 305-314.