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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

$$\rho = \frac{dw+m}{V_{dw}+V_w} = \frac{M}{V_{dw}+V_w}, \tag{1}$$

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

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

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),

$$\rho = 1{\cdot}208 - 0{\cdot}193\,X. \tag{3}$$

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 $X = 0{\cdot}5$, 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,

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

* 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 li[illegible] 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,

$$\frac{1}{\rho} = 0{\cdot}821 + 0{\cdot}159X. \tag{5}$$

Equations (4) and (5) now give $\rho_s = 1{\cdot}218$ and $\rho_w = 1{\cdot}020$ g/cm^3, 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.