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SQUARE FUNCTION DESCRIBES THE DEPENDENCE OF THE ACTIVATION ENERGY OF VISCOUS FLOW ON TEMPERATURE FOR OVALBUMIN IN AQUEOUS SOLUTIONS

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The activation energy of viscous flow ΔE is usually defined as a minimum energy required for a molecule to escape the influence of its neighbouring molecules. In many cases, it is obtained from the slope of the line that represents the dependence of ln η versus T^{-1} (η is a viscosity and T – the absolute temperature of the liquid). More strict definition, which allows calculation of ΔE at the individual temperature is: $\Delta E = R[d\ln \eta/d(T^{-1})]$, where R is the gas constant. The viscosity-temperature dependence for globular proteins solutions – in a wide range of temperatures – can be precisely described by a modified Arrhenius formula (Monkos, 1996, *Int. J. Biol. Macromol.,*18, 61), which leads to the following relationship between the activation energy of viscous flow of a solution $\Delta E(c,T)$ and T:

$$\Delta E(c,T) = \Delta E_s(c) - RD_s(c)T^2$$

$\Delta E_s(c)$ and $D_s(c)$ denote the activation energy at T = 0 and the rate of decreasing of the activation energy with increasing temperature, respectively. Both quantities – at fixed concentration *c* – can be obtained from a modified Arrhenius equation. The viscosity measurements for ovalbumin aqueous solutions were performed using an Ubbelohde-type capillary microviscometer over a wide range of concentrations and at temperatures ranging from 5°C to 55°C in 5°C intervals. A modified Arrhenius formula and the above equation were then applied to the calculation of $\Delta E(c,T)$. The activation energy of a solution is a superposition of the activation energy of water $\Delta E_w(T)$ and dissolved proteins $\Delta E_p(T)$. As appears, $\Delta E_p(T)$ fulfils exactly the same equation as the above one:

$$\Delta E_p(T) = \Delta E_p - RD_pT^2$$

and, for ovalbumin, $\Delta E_p = (8.49 \pm 0.46) \times 10^7$ J/mol and $D_p = (86.4 \pm 5.4)\ K^{-1}$.