Thermodynamic Analysis of Interacting Biological Systems (Chun's Method)

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We have examined $\Delta G^o(T)$ data from 28 interacting biological systems, 35 sequence-specific dipeptide hydrophobic interactions and micellization in six surfactants. Data analysis based on the fitting function of $\Delta G^o(T) = \alpha + \beta T^2 + \gamma T^3$ from each of these systems confirms the existence of a thermodynamic molecular switch, where a change of sign in $\Delta Cp^o(T)_{\text{reaction}}$ from positive to negative leads to a negative minimum in the Gibbs free energy of reaction, and hence a maximum in the related $K_{\text{eq.}}$ The critical factor in this thermodynamic switch is the $\Delta Cp^o(T)_{\text{reaction}}$, which determines the behavior patterns of the Gibbs free energy change as well as other thermodynamic functions. Application of Chun's methodology based on the Planck-Benzinger thermal work function to biological systems always conforms to the basic rules governing life processes in that there is a lower cutoff point, $<T_h>$, where $\Delta H^o(T_h)(+) = T\Delta S^o(T_h)(+)$, and upper cutoff point $<T_m>$, where $\Delta H^o(T_m)(-) = T\Delta S^o(T_m)(-)$. After precise determination of thermodynamic variables $<T_{cp}>$, $<T_h>$, and $<T_m>$, it is possible to establish the thermal set point $<T_S>$ of any interacting biological system, where the system is at its most stable, $\Delta G^o(T_S)(-)_{min} = \Delta H^o(T_S)(-)$ and $T\Delta S^o(T_S) = 0$. Between, the compensatory temperatures, $<T_h>$ and $<T_m>$, where $\Delta G^o(T) = 0$, the net chemical driving force is favorable for interacting biological processes. For water vapor condensation, $<T_h>$ and $<T_m>$ are 30K and 380K. As water is a part of every living system, this suggests that the thermal set point for all biological interactions must fall between the limits of 30K and 380K. The Planck-Benzinger thermal work function provides a means of determining the innate temperature-invariant enthalpy and thermal agitation energy, or the heat capacity integrals, and it is the best method for determining the heat of reaction $[\Delta H^o_{298} - \Delta H^o(T_o)]$, in biological systems.

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