THERMAL DENATURATION OF BIOMOLECULES AT NORMAL BODY TEMPERATURE

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According to the laws of chemical kinetics, all organisms must suffer some degree of thermal injury even at normal body temperature. The important question is whether the slow thermal denaturation of proteins and nucleic acids at 37°C is trivial or whether it may account for a significant loss of essential biological information during the life of a cell or an organism and may thus be a factor in determining its lifespan.

The loss of proliferative capacity of hamster fibroblasts in vitro due to elevated temperatures (41-46°C) has the thermodynamic characteristics of a denaturation reaction. The rates of cell loss from the proliferative pool due to thermal denaturation at elevated temperatures can be extrapolated to 37°C, giving an expected loss of 0.2% of cells per hour due to thermal denaturation reactions at physiological temperature.

That such a rate of loss from the proliferative pool does in fact occur at physiological temperature can be shown by comparing cell generation time with population doubling time. The slow thermal denaturation of essential biomolecules at 37°C accounts for nearly all of the spontaneous loss of proliferative function in these cells in vitro, and it may be a primary factor in the time dependent loss of function of cells in vivo.

References:

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- 3) Johnson, H.A. (1974) Am. J. Pathol. 75, 13.