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A study of the temperature dependence of bienzyme systems and enzymatic chains

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Abstract

It is known that most enzyme-facilitated reactions are highly temperature dependent processes. In general, the temperature coefficient, Q10, of a simple reaction reaches 2.0-3.0. Nevertheless, some enzyme-controlled processes have much lower Q10 (about 1.0), which implies that the process is almost temperature independent, even if individual reactions involved in the process are themselves highly temperature dependent. In this work, we investigate a possible mechanism for this apparent temperature compensation: simple mathematical models are used to study how varying types of enzyme reactions are affected by temperature. We show that some bienzyme-controlled processes may be almost temperature independent if the modules involved in the reaction have similar temperature dependencies, even if individually, these modules are strongly temperature dependent. Further, we show that in non-reversible enzyme chains the stationary concentrations of metabolites are dependent only on the relationship between the temperature dependencies of the first and last modules, whilst in reversible reactions, there is a dependence on every module. Our findings suggest a mechanism by which the metabolic processes taking place within living organisms may be regulated, despite strong variation in temperature.

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