COMMENTARY

Detection of multiple protein conformations by laser-polarized xenon

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[This paper is a commentary on the paper *Distinguishing multiple chemotaxis Y protein conformations with laser-polarized ^{129}Xe NMR* by Lowery et al. in this issue.]

The present contribution highlights a remarkable progress in biomolecular NMR spectroscopy. The xenon isotope ^{129}Xe is an NMR active spin-1/2 nucleus. It has been introduced into surface NMR spectroscopy by Ito and Fraissard (1982). Since then, xenon has become one of the most frequently used probes in the NMR spectroscopy of materials such as zeolites, clathrates, polymers, and many others. The reason for this success is the extremely sensitive NMR chemical shift of ^{129}Xe. The introduction of so-called laser-polarized ^{129}Xe (see, e.g., Happer et al. 1984) into surface NMR spectroscopy (Raftery et al. 1991) has lead to a remarkable enhancement of sensitivity.

A few years ago, the groups of Pines and Wemmer (University of California at Berkeley) as well as Bartik, Luhmer, and coworkers (Université Libre de Bruxelles, Brussels) started to apply ^{129}Xe NMR spectroscopy to biomolecules in solution. It has been shown in a series of studies (see, e.g., Rubin et al. 2000, 2002; Locci et al. 2001) that the ^{129}Xe NMR chemical-shift sensitively detects the presence of biomolecules in a solution. Specific binding of xenon into so-called hydrophobic cavities particularly influences the ^{129}Xe NMR chemical shift. Triggered by these observations, the NMR-spectroscopic investigation of hydrophobic cavities in proteins using xenon currently finds a variety of applications and new methodical developments (see, e.g., Landon et al. 2001; Gröger et al. 2003; Dubois et al. 2004).

The merit of the present study by Lowery et al. (2005) is to show the sensitivity of the ^{129}Xe NMR chemical shift to detect four different Chemotaxis Y (CheY) protein conformations in solution. This is the first example for the detection of more than two conformational states of a single protein in solution by ^{129}Xe NMR. Furthermore, the sensitivity of the ^{129}Xe NMR chemical shift to protein–peptide binding is demonstrated for the first time. These important observations open the way to many interesting future experiments: The detection of conformational changes is of special biological relevance, since the adaptation of proteins to their various functions is often achieved by relatively small conformational changes of the molecules; and this is exactly the reason that makes the present contribution another very striking example for the usefulness and increasing importance of ^{129}Xe NMR spectroscopy in biology.

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Article and publication are at http://www.proteinscience.org/cgi/doi/10.1110/ps.051398705.

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