LIFE SCIENCE:

MEDICAL BIOLOGY

The articles in this 2008 volume demonstrate the diversity of biological studies at SPring-8. Three diffraction studies in reciprocal space and three imaging studies in real space are reported.

Protein solution X-ray scattering is becoming a common tool in structural biology. Since this technique usually uses scattering data in a small-angle region, its spatial resolution is inherently low. However, Kamikubo and Kataoka proposed a method of analyzing wide-angle scattering data to obtain more detailed structure of a protein. They used photoactive yellow protein as a model. Its wide-angle scattering data contains information on secondary-structure packing and tertiary folds. By comparing scattering data from proteins with different chain lengths, they interpreted the wide-angle data and further demonstrated a change in the packing of secondary structures in the transient states of photoreception.

Matsuo and Yagi used X-ray fiber diffraction to study the regulation of contraction in frog skeletal muscles. Although the control of contraction by Ca in skeletal muscle is established, it has not been correlated in detail with the molecular changes associated with contraction. X-ray diffraction can give clues to both the binding of Ca to the regulatory protein troponin and the interaction of myosin heads with actin. The difference in the responses of these events to an electrical stimulus explains the phenomenon of summation in skeletal muscle contraction.

Kubo and her colleagues used microbeam X-ray diffraction for the structural analysis of starches in rice, the most important agricultural product in Japan. By scanning kernels of mutant rice with a 5 μm microbeam, they studied starch localization and the crystalline structure of starch. The results showed that the branch chain length of polyglucans is crucial in determining the starch crystalline structure.

There are three articles on imaging experiments. Sera overcame technical difficulties to record computed tomography (CT) images of a live mouse at different stages of cardiac and respiratory cycles. Since it is necessary to work on live animals in physiological studies, this "4D" tomography is essential for applying CT to important medical problems.

Schwenke and his colleagues used microangiography to study pulmonary arterial hypertension. They were able to visualize blood vessels down to 80 μm in diameter. The important finding is that there are few small vessels in this diseased state. This must be the causal factor for the increase in pulmonary arterial pressure.

Shinohara and his colleagues used phase-contrast tomography to examine a coronary atherosclerotic plaque. Owing to the high contrast resolution of this technique, collagen-rich and lipid-rich regions, which are important in differentiating stable and unstable plaques, were clearly visualized.

Both diffraction and imaging techniques are quite effective in studying biological structures in their native state. These articles show that SPring-8 is utilized by researchers from diverse fields of biology and medicine.

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