LOW SALT INDUCED CATARACT IN DOGFISH (SQUALUS ACANTHIAS) EYE LENSES

Roland J. Siezen and Elizabeth D. Kaplan, Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139

Cataracts can be induced in the nucleus of isolated calf lenses by incubation in high salt media; these are reversible upon lowering the ionic strength to physiological levels of 0.15 - 0.20 (Benedek et al, Phil. Trans. R. Soc. Lond. A293, 1979, 329-340). The molecular mechanisms responsible for this enhanced light scattering are not clear, but they may be described as a phase separation within the lens cell cytoplasm (Clark and Benedek, Biochem. Biophys. Res. Commun. 95, 1980, 482-489). Since marine fish are continuously exposed to a high salt environment, with ionic strengths of 0.6 - 0.7, we questioned what the effect of variations in salt concentration would be on the transparency of dogfish eye lenses.

Seven fresh dogfish (Squalus acanthias) lenses, each weighing about 0.7 gram, were incubated at room temperature in 5 ml buffer each of increasing ionic strength I from 0 (H_2O) to 0.6. Phosphate buffers up to 0.1 M were used, with NaCl added to the specified ionic strengths. All buffers contained EDTA, dithiothreitol and sodium azide.

Lenses were photographed after 24 hours (Fig. 1a). At I=0.6 and 0.5 lenses remain perfectly clear (even after many days incubation); from I=0.4 down, opacities are formed. These begin as nuclear cataracts and progress to whole lens opacities at the lowest ionic strength. Considerable lens swelling occurs below I=0.3. Subsequent incubation of all lenses for 24 hrs. in I=0.6 buffer produced complete reversal of the nuclear opacities in all lenses (Fig. 1b). A faint ring remains visible between nucleus and cortex, while some cortical haziness remains in lenses previously incubated below I=0.3.

The effect of salt concentration on transparency of fish lenses is exactly opposite to that described for calf lenses. Further comparison of the constituent lens proteins will be performed to determine the molecular mechanisms of opacification involved in these ionic imbalance cataracts. Supported by the Lucille Markey Charitable Trust.

Fig. 1 (a) Dogfish lenses incubated for 24 hrs in buffers of ionic strength, from left to right, 0-0.1-0.2-0.3-0.4-0.5-0.6.
(b) The same lenses after subsequent incubation in I = 0.6 buffer for 24 hrs.