EXPRESSION OF EXTRAOCULAR OPSIN GENES AND LIGHT-DEPENDENT BASAL ACTIVITY OF BLIND CAVEFISH

BACKGROUND

Animals living in well-lit environments utilize optical stimuli for detecting visual information, regulating the homeostatic pacemaker, and controlling patterns of body pigmentation. In contrast, many subterranean species living without optical stimuli have evolved regressed binocular eyes and body pigmentation. Interestingly, some fossorial and cave-dwelling animals with regressed eyes still respond to light. These light-dependent responses may simply be evolutionary residuals or they may be adaptive, in which case move to positive phototaxis helps animals avoid predator-rich surface environments. However, the relationship between these non-ocular light responses and the underlying light-sensing Opsin proteins has not been fully elucidated.

Based on conservative criteria, we identified 33 opsin genes in the cavefish genome. Surveys of available RNA-seq data found 26 of these were expressed in the surface fish eye and 24 were expressed in cavefish extraocular tissues, 20 of which were expressed in the brain.

RESULTS

To indicate how opsins may function in a blind subterranean animal, we used the Mexican cave tetra to investigate opsin gene expression in the eyes and several brain regions of both surface- and cave-dwelling adults.

METHODS

We performed database surveys, expression analyses by quantitative reverse transcription PCR (RT-qPCR), and light-dependent locomotor activity analysis using pinealectomized fish.

PHYOGENY AND RELATIVE EXPRESSION LEVELS OF ASTYANAX OPSINS

The phylogeny illustrates the evolutionary relationships among cave fish (red branches) and surface fish (yellow branches). The expression levels were measured in cavefish extraneural tissues, 20 of which were expressed in the brain.

CONCLUSION

We conclude that, after 20,000 or more years of evolution in darkness, cavefish’s light-dependent basal activity is regulated by a non-pineal extraocular organ.