Ecology, physiology and behaviour

Comparative study on auditory physiological structure and function between the mandarin vole and the Brandt's vole

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Mammals' auditory capabilities are influenced by social behaviour, habitat, and developmental stages. Research on rodent hearing has evolved from studying morphology to cochlear mechanisms and molecular levels. Current studies on surface-active rodents primarily examine age-related hearing loss and the effects of high-altitude hypoxia on auditory function. In contrast, research on subterranean rodents focuses on their low-frequency hearing mechanisms. These rodents, living in dark underground burrows, have adapted their communication and auditory physiology to their environment, favouring mid-low frequency sounds while being less sensitive to high frequencies compared to surface-active rodents. For example, the specialized auditory structures in subterranean rodents may compensate for diminished other senses. By comparing the auditory abilities, structural differences, and molecular mechanisms of hearing between subterranean and surface-active rodents, we can understand the adaptability and changes in auditory systems across different environments, offering insights into the evolution and function of these systems.

The present study compares the auditory physiological differences between a subterranean rodent, the mandarin vole (*Lasiopodomys mandarinus*), and a surface-active rodent, the Brandt's vole (*Lasiopodomys brandtii*), to elucidate the adaptive evolution of their auditory systems to unique acoustic environments. Auditory capabilities were assessed using Auditory Brainstem Response (ABR) tests. The results showed that the auditory ranges of the mandarin vole and the Brandt's vole are similar, with overlapping sensitive frequency ranges, and the most sensitive frequencies lie between 5000 and 7000 Hz. The average auditory thresholds of the mandarin vole in the 500-2000 Hz and 16000-24000 Hz frequency bands are comparable to those of the Brandt's vole. However, significant differences were observed: the click threshold of the mandarin vole is significantly higher than that of the Brandt's vole; the auditory thresholds of the mandarin vole at frequencies between 4000 and 12000 Hz are significantly higher than those of the Brandt's vole; and the average auditory thresholds of the mandarin vole between 2000 and 16000 Hz are higher than those of the Brandt's vole. These findings suggest that the mandarin vole has weaker auditory capabilities than the Brandt's vole, possibly indicating auditory degeneration during the adaptive evolution to the subterranean environment. Comparison of the tympanic bulla structures revealed that the mandarin vole has a shorter tympanic bulla diameter, smaller tympanic bulla spacing, and a narrower external width compared to the Brandt's vole. Additionally, the tympanic bulla of the Brandt's vole is more fragile with a thinner external wall. Micro-CT and histological section observations of the cochlear structures showed typical spiral configurations in both species, with the cochlea of the mandarin vole being flatter than that of the Brandt's vole.