

Functional regulation of acid secretion in zebrafish during acclimation to acidic environment

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Maintaining the internal hydromineral homeostasis during acclimation to harsh environments is a critical issue in fish; however the molecular and cellular mechanisms behind the acclimation process are largely unknown. In zebrafish, H⁺-ATPase-rich (HR) cells were identified to be involved in acid secretion in the gills and skin. HR cells in zebrafish embryonic skin were found to modulate the apical surface and H⁺ secretion function within 10-30 min after acute transfer from pH7 to pH4 or the reverse direction. The H⁺ secretion function was upregulated in pH4 water not only by increasing the cell number but also by enlarging the acid-secreting function of single cell. The densities of epidermal stem cells (p63 as the marker) in zebrafish skin had increased at 30 h after exposure to pH4. On the other hand, the expression of H⁺-ATPase and GCM2 (a transcription factor controlling HR cell's differentiation) in zebrafish gills were stimulated from 96 h post transfer to pH4. In conclusion, to cope with acidic environment, zebrafish appear to acutely modulate the existing mechanisms (transporters and ionocytes), and for long-term acclimation, increase ionocyte number (through cell proliferation/differentiation) and synthesize more transporters, resulting in an enhancement of the overall acid secretion function.