

Changes in gene expression during hypoxia and starvation in fish  
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Fish respond to starvation and hypoxia by inhibiting reproduction and reducing activity, oxygen consumption and energy expenditure. Hypoxic carp stopped feeding during the first few days of hypoxic exposure but begin to feed after 2 to 4 days, thus the hypoxic response includes starvation. There are negligible changes in gene expression during the first 2 weeks of starvation, so starvation in the first few days of hypoxia is unlikely to contribute to any changes in gene expression. Changes in gene expression in liver are earlier and larger during hypoxia compared with starvation. There is early massive suppression of most renal genes during both starvation and hypoxia. Feeding is an energy-expensive process. Fish eat when food is available and there is energy to process the food. Some changes in gene expression late in hypoxia are probably related to restoration of feeding, for example, biosynthetic, transporter and metabolic genes are suppressed but return to control levels during prolonged hypoxia when feeding restarts. These changes in gene expression ensure that protein/enzyme production is matched to the energy requirements of the cell. The obvious difference is that anaerobic genes are activated during hypoxia but not starvation.