

# A metabolic approach to understanding adaptation to sea water by endangered Persian sturgeon, *Acipenser persicus* fingerlings

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## Abstract

In this study, metabolic responses of Persian sturgeon fingerlings to hyperosmotic condition were investigated by NMR-based metabolomics. Persian sturgeon fingerlings ( $n = 2010$ , mean total weight:  $3.2 \pm 0.6$  g; mean total length:  $8.5 \pm 1.5$  cm) were held in freshwater (FW) for 96 hr and then acclimated in brackish water (BW) (12 g/L) for 24 hr. Blood samples were taken before and after salinity acclimation. The major metabolite changes corresponding to salinity acclimation were related to amino acids, osmolytes and energy metabolites. The plasma glucose levels increased significantly after 24 hr acclimation in BW ( $p < .05$ ). Other energetic metabolites (acetate, acetoacetate, beta-hydroxybutyrate, phosphocreatine, creatine, glycerol) showed no significant changes after 24 hr salinity challenge ( $p > .05$ ). The osmolytes (taurine, trimethylamine-N-oxide, choline, *N,N*-dimethylglycine) and amino acids (aspartate, glutamate, glutamine, leucine, phenylalanine,  $\beta$ -alanine, histidine, threonine, cysteine) declined significantly after 24 hr acclimation in BW ( $p < .05$ ). However, the levels of glycine elevated after 24 hr acclimation in BW ( $p < .05$ ). Other amino acids including asparagine, isoleucine, Tyrosine, Tryptophan, Valine, and Lysine showed no significant changes after salinity challenge ( $p > .05$ ). The considerable decreases in almost all plasma amino acids and all osmolytes showed specific importance of these metabolites in osmotic adaptation of fish in BW. Also, it seems that Persian sturgeon fingerlings rely more on oxidation of glucose to meet energetic requirements of osmoregulation than oxidation of lipids, as we observed no detectable changes in metabolites associated with lipid oxidation during osmotic acclimation in BW. Our results may help to understand osmoregulation in a chondrostei fish species from a metabolic approach.

## KEYWORDS

amino acid, metabolomics, osmolyte, osmoregulation, Persian sturgeon

## 1 | INTRODUCTION

The physiology of osmoregulation has been well documented in teleosts and to some extent in chondrostei (Reviewed by McCormick, 2001; Martinez-Alvarez et al., 2002; Khoshnood, Khodabandeh & Mosafer, 2008; Farabi, Najafpour, Ghiasi & Samadi, 2011). Until

now, fish osmoregulation has been studied in various physiological levels including hormones, enzymes, electrolytes and histology. Cortisol as a major corticosteroid hormone secreted by the interrenal gland and has been proven to be most important in seawater (SW) adaptation in teleost fish (Reviewed by McCormick, 2001) and also in sturgeons (Farabi et al., 2011; Krayushkina, Semenova, Vyushina