

## Interactive Effects of Ammonia and Salinity on Digestive Enzymes and Intestinal and Kidney Tissue in Fingerlings of Starry Sturgeon (*Acipenser stellatus*)

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### Abstract

This study aimed to investigate changes in digestive enzymes and the intestinal and kidney tissue in the starry sturgeon (*Acipenser stellatus*) fingerlings exposed to different levels of ammonia and salinity. This research was conducted in 2018 in the Guilan sturgeon research station (Chaboksar) in two stages. In the first stage, the LC<sub>50</sub>-96h of ammonia (ammonium chloride) was determined to the starry sturgeon at different salinities (0, 4, 8, and 12 g/L<sup>-1</sup>). Then 240 fingerlings of the starry sturgeon, with mean weight and length of 15.23±2.17 g and 17.00±1.95 cm, respectively, were exposed to half of the LC<sub>50</sub>-96h (3.71, 4.12, 4.80, and 5.11 ppm) at the same salinities (eight treatments with three replicates apiece). The results showed that the tolerance of subjects increased with the increase in ammonia concentration at different salinities (0, 4, 8, and 12 g/L<sup>-1</sup>), indicating a reduction in the toxicity of ammonia to subjects. The increased salinity reduced the activity of digestive enzymes in subjects exposed merely to different salinities (P>0.05). The increased salinity and ammonia levels increased the activity of amylase and protease but reduced the activity of lipase in combination treatments (both salinity and ammonia) (P>0.05). Histopathological studies indicated that tubules destruction, nucleus resorption, glomerular necrosis, and Bowman's space enlargement were the most common lesions in the kidney. These lesions were more severe in Treatment 8 (salinity: 12 g/L<sup>-1</sup> and ammonia: 5.11 ppm) as the salinity increased in the presence of ammonia. The simultaneous increase in ammonia and salinity levels caused histopathological lesions in the intestine such as the submucosal layer destruction, flattened intestinal villi, deformation of the lamina propria, and the destruction of the cylindrical epithelial cells. Histopathological observations also revealed that higher levels of salinity and ammonia caused the further destruction of intestinal tissue. It can be hence concluded that although the increased salinity reduced the toxicity of ammonia to subjects, it caused evident histopathological lesions in the intestine and kidney as well as changes in digestive enzymes.

**Keywords:** Ammonia, Salinity, Digestive enzymes, Intestinal and kidney lesions, Starry sturgeon, *Acipenser stellatus*.