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Original Article

Some physiological and nutritional responses of common carp *Cyprinus carpio* juveniles to osmotic stress

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Abstract: The effect of salinity (<1, 7, and 15 ppt) on some physiological and nutritional parameters of common carp (*Cyprinus carpio*) juveniles was examined in two trials. In the first trial, the activity of the common liver enzymes (alkaline phosphatase ALP, Aspartate transaminase AST, and Alanine transaminase ALT) in the blood serum, and total plasma protein level on the 1st, 7th, and 14th day of exposure, using 90 fish (14.05±2.01 g) were studied. In the second trial, the growth and feed efficiency performance (weight gain WG, relative growth rate RGR, specific growth rate SGR, and feed conversion ratio FCR), and apparent digestibility coefficients ADCs of dry matter, nutrients, and energy were investigated during ten ten-week rearing period using another 90 fish (15.71±1.59 g). The results showed that the activity of the ALP was increased significantly ($P \leq 0.05$) with increasing salinity on the 1st day, and continued to the following 7th and 14th day periods. AST in 7 and 15 ppt showed significantly ($P \leq 0.05$) higher activity levels compared with 1 ppt on the 1st day, similar differences were found on the 7th and 14th day for 15 ppt, but not for 7 ppt during the same periods. ALT exhibited significantly ($P \leq 0.05$) higher activity in 7 and 15 ppt relative to <1 ppt during all periods. Total plasma protein fluctuated slightly ($P > 0.05$) on the 1st and 7th day and decreased significantly ($P \leq 0.05$) in 15 ppt only on the 14th day. Significantly ($P \leq 0.05$) better specific growth rate SGR and feed conversion ratio FCR were observed in the lowest salinity (<1 ppt) while the worst in the highest (15 ppt). The ADCs of dry matter, nutrients, and digestible energy were decreased significantly ($P \leq 0.05$) with increasing water salinity.

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Introduction

Climate change causes a continuous decrease in freshwater resources and a change in its quality, especially the high levels of salinity, which exposes fish to osmotic stress (UNESCO, 2021). The changes in the salinity of the water bodies cause osmotic stress due to their effects on physiological homeostasis and routine biological processes (Kültz, 2015) .The increase in water salinity is a source of environmental stress, which stimulates several responses in fish to deal with the physiological changes, such as changes in the concentration of hormones, the concentration of basic substances in the plasma, the change in the size and number of blood cells, the functional changes that are observed in the members of the osmoregulatory system, and other functions involving the digestive system (Teles et al., 2021).

Salt stress occurs with rapid and sudden changes in the salt concentrations of the aquatic environment, for example, due to tidal flows, rainstorms, droughts, or evaporation from small bodies of water. However, gradual changes in salt concentration can also cause osmotic stress in aquatic environments if levels exceed limits that reduce the resistance of resident organisms (Evans and Kültz, 2020). Moving or transporting some fish species from freshwater to seawater causes some hormonal and physiological changes as well as a loss of energy, which may eventually affect the growth of the fish (Whitfield, 2015). Salinity is one of the most important environmental factors influencing the survival, growth, and distribution of fish. Many studies show that high levels of salinity increase energy requirements and decrease feeding rates in fish to maintain internal stability and maintenance (Takei et al., 2014; Takei and Hwang, 2016).

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