



## Effects of Chronic Toxicity of Bensulfuron-Methyl on Hematological and Serum Biochemical Markers and Liver Tissue of Common carp (*Cyprinus carpio*)

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Received: 4 July 2023, Accepted: 13 September 2023



[10.22059/jvr.2023.362740.3370](https://doi.org/10.22059/jvr.2023.362740.3370)



[20.1001.1.20082525.1402.78.4.3.1](https://doi.org/10.1001.1.20082525.1402.78.4.3.1)

### Abstract

**BACKGROUND** Agricultural pesticides can cause environmental pollution and damage to aquatic organisms. Bensulfuron-methyl is a widely used herbicide in agricultural fields, especially rice fields. Despite the solubility of Bensulfuron-methyl in water and its entry into aquatic environments, limited research has been conducted on the toxicity of this herbicide in aquatic organisms.

**OBJECTIVES:** This study aims to investigate the effects of chronic toxicity of Bensulfuron-methyl in common carp (*Cyprinus carpio*).

**METHODS:** The fish were divided into four groups. Group 1 was considered as a control, and groups 2, 3, and 4 were exposed to 10 %, 20 %, and 30 % of the 96 h lethal concentration 50 of Bensulfuron-methyl equal to 0, 0.162, 0.324 and 0.486 g/L. After 21 days, blood samples, serum levels, and liver tissue of fishes were analyzed.

**RESULTS:** The number of white blood cells increased in groups 2 and 3 (received 0.162 and 0.324 g/L Bensulfuron-methyl) compared to group 1, while a significant decrease was observed in group 4 (received 0.486 g/L Bensulfuron-methyl) compared to other groups. The number of red blood cells, the amount of hemoglobin, and the percentage of hematocrit in groups 3 and 4 showed a significant decrease compared to other groups, and the values of mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration were not significantly different in any groups. The amount of total serum protein in groups 3 and 4 decreased significantly compared to the control group. Serum glucose showed a significant increase in groups 3 and 4 compared to other groups. The values for aspartate aminotransferase, alanine transaminase, and alkaline phosphatase enzymes showed an increasing trend with the increase of Bensulfuron-methyl concentration. The most liver tissue damage was observed in group 4, which included hyperemia, hepatocyte vacuolar degeneration, edematous cell infiltration, bile duct hyperplasia, and hepatic necrosis.

**CONCLUSIONS:** The increase in the concentration of Bensulfuron-methyl can cause liver tissue damage and changes in hematological and serum biochemical markers in common carp.

**Keywords:** Bensulfuron methyl, *Common carp*, Hematology, Liver, Toxicology

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Publisher: University of Tehran

Conflict of interest: The authors declared no conflict of interest.

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### How to cite this article:

Rahmani Khangahi F, Omidzahir S, Movahedinia A, Akhoundian M. Effects of Chronic Toxicity of Bensulfuron-Methyl on Hematological and Serum Biochemical Markers and Liver Tissue of Common carp (*Cyprinus carpio*). J Vet Res, 2023; 78(4): 259-271. doi: 10.22059/jvr.2023.362740.3370

### Figure Legends and Table Captions

**Table 1.** Mean serum levels in different groups. Note: the letters above numbers indicate significant differences among group).

**Table 2.** Type and severity of the damage observed in the liver tissue. Note: - indicates no damage; + mild damage, ++ moderate damage, and +++ severe damage.

**Figure 1.** Mean level of hematological markers in different groups. Note: the letters in the columns indicate significant differences among groups.

**Figure 2.** Liver tissue, H&E staining (×40). (A) group 1 or control, (B) group 2 (received 0.162 g/L Bensulfuron-methyl), (C) and (D) group 3 (received 0.324 g/L Bensulfuron-methyl), (E) and (F) group 4 (received 0.486 g/L Bensulfuron-methyl). Arrow 1 indicates hepatocyte vacuolar degeneration; arrow 2 shows hyperemia; arrow 3 shows edematous cell infiltration; arrow 4 shows hepatic necrosis; and arrow 5 indicates bile duct hyperplasia.