

# Effect of Methylsulfonylmethane on Paraquat-Induced Acute Lung and Liver Injury in Mice

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**Abstract**—Methylsulfonylmethane (MSM) is a natural organosulfur compound that exhibits antioxidative and anti-inflammatory effects. This study was carried out to investigate the effect of MSM on paraquat (PQ)-induced acute lung and liver injury in mice. A single dose of PQ (50 mg/kg, i.p.) induced acute lung and liver toxicity. Mice were treated with MSM (500 mg/kg/day, i.p.) for 5 days. At the end of the experiment, animals were euthanized, and lung and liver tissues were collected for histological and biochemical analysis. Tissue samples were used to determine malondialdehyde (MDA), myeloperoxidase (MPO), catalase (CAT), superoxide dismutase (SOD), glutathione (GSH), and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) levels. Blood samples were used to measure plasma alanine transaminase (ALT),  $\gamma$ -glutamyl transferase (GGT), and alkaline phosphatase (ALP). Histological examination indicated that MSM decreased lung and liver damage caused by PQ. Biochemical results showed that MSM treatment significantly reduced tissue levels of MDA, MPO, and TNF- $\alpha$ , while increased the levels of SOD, CAT, and GSH compared with PQ group. MSM treatment also significantly reduced plasma levels of ALT, GGT, and ALP. These findings suggest that MSM as a natural product attenuates PQ-induced pulmonary and hepatic oxidative injury.

**KEY WORDS:** methylsulfonylmethane; paraquat toxicity; liver injury; lung injury.

## INTRODUCTION

Poisoning by agricultural chemicals is an important public health problem worldwide particularly in developing countries. Paraquat (1,1'-dimethyl-4,4'-bipyridinium chloride; PQ) is one of the most widely used herbicide in agriculture. PQ is a highly toxic compound for humans and can cause severe damages to many organs such as lungs, liver, and kidneys. The toxic effects of PQ are due to its ability to induce oxidative stress, inflammatory, and fibrotic reactions [1, 2]. PQ redox cycling and subsequent generation of reactive oxygen species (ROS) is the main mechanism of its toxicity. After entering cells, PQ is reduced to an unstable radical which is then re-oxidized to form a cation and generates a superoxide anion ( $O_2^{\cdot-}$ ). The PQ radical also causes formation of hydroxyl free radical

( $HO^{\cdot}$ ) and peroxynitrite ( $ONOO^-$ ) inside the cells [3, 4]. Generation of highly reactive oxygen and nitrite species induces lipid peroxidation of cellular membranes leading to functional disorders in several organs particularly in the lungs and liver. The lung is the primary target organ of PQ, and respiratory failure from pulmonary fibrosis is the most common cause of death [4].

Although there is no effective antidote for PQ poisoning as yet, there are various treatments, such as immunosuppressant, anti-inflammatory, and antioxidant drugs that have been used to relieve symptoms of poisoning.

Methylsulfonylmethane (MSM) is a natural organosulfur compound and occurs in small amounts in some green plants, fruits, and vegetables. MSM, also known as dimethyl sulfone, is a dietary supplement and is believed to be nontoxic to humans [5]. Humans do not synthesize MSM, but obtain it in their diet. MSM, often with glucosamine and chondroitin, has usually been used to treat or prevent osteoarthritis. It has been reported that MSM relieves arthritis pain and improves physical function in patients with knee osteoarthritis [6, 7]. This compound has been shown to be effective in treating or

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