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A Review on Protective Effect of *Aloevera Barbedensis* on Heamatologiacal Parameters of Albino Rat after Diazinon Intoxication

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Abstract

The widespread use of diazinon, an organophosphate pesticide, has sparked serious worries because of its harmful effects on both humans and animals. Diazinon mainly works by blocking acetylcholinesterase, which leads to an overload of cholinergic activity, oxidative stress, and disturbances in blood parameters. Being exposed to it can result in conditions like anemia, leukocytosis, thrombocytosis, and other blood-related issues, which can hinder oxygen transport, weaken immune function, and upset the body's overall balance. Therefore, monitoring hematological parameters is crucial for evaluating toxicity. Aloe vera (*Aloe barbadensis Miller*), a medicinal plant packed with polysaccharides, flavonoids, anthraquinones, vitamins, and enzymes, shows impressive antioxidant, anti-inflammatory, immunomodulatory, and protective qualities. Research suggests that taking Aloe vera can help restore red blood cell counts, hemoglobin levels, and hematocrit, while also normalizing white blood cell and platelet counts, thus reducing the harmful effects of diazinon on blood health. Its ability to modulate the immune system also supports bone marrow function and boosts overall immune defense.
Keywords: Diazinon toxicity, Hematological parameters, Aloe vera

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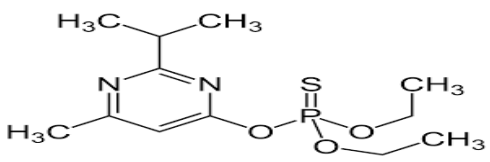
Introduction

The growing reliance on organophosphate pesticides in farming has sparked serious worries about their harmful effects on both the environment and human health. One such pesticide, diazinon, is commonly used to tackle a wide variety of pests in crops, home gardens, and livestock areas. While it's effective, diazinon comes with significant health risks because it can block acetylcholinesterase (AChE), an enzyme crucial for transmitting nerve signals, which can lead to cholinergic toxicity (Kaur *et al*., 2019). Whether through long-term or short-term exposure, diazinon can cause oxidative stress, damage to cells, and changes in various physiological and biochemical markers in animals, including shifts in blood parameters. These changes can weaken the immune system and disrupt overall balance in the body, making diazinon poisoning a vital topic for toxicology research. Hematological parameters are key indicators that provide insight into the health and disease states of living organisms. Factors like red blood cell (RBC) count, hemoglobin (Hb) concentration, hematocrit (HCT), white blood cell (WBC) count, and platelet levels are particularly sensitive to exposure to toxic substances. For instance, organophosphate pesticides such as diazinon can lead to conditions like anemia and leukocytosis, along with other blood-related disorders, primarily through mechanisms that involve oxidative stress and disruption of blood cell production (Odewumi *et al*., 2020). In studies using models like albino rats, changes in hematological parameters are seen as reliable signs of overall toxicity and immune system imbalance following pesticide exposure. With growing worries about the toxicity of pesticides, there's been a noticeable shift towards using natural antioxidants and phytochemicals as protective agents. Take Aloe vera (Aloe barbadensis Miller), for instance. This medicinal plant, part of the Liliaceae family, has been the focus of extensive research due to its impressive pharmacological benefits, which include antioxidant, anti-inflammatory, immunomodulatory, and hepatoprotective properties (Surjushe *et al*., 2008). Aloe vera is packed with a variety of bioactive compounds—think vitamins A, C, and E, along with polysaccharides, phenolic compounds, flavonoids, and enzymes all of which work together to enhance its therapeutic effects (Radha & Laxmipriya, 2015). Its strong antioxidant capabilities are vital for neutralizing reactive oxygen species (ROS), helping to shield cells from oxidative damage caused by harmful substances like diazinon. Several studies have shown that Aloe vera can protect the blood from various toxins. For instance, it has been found that Aloe vera supplementation can boost the production of red blood cells, help restore hemoglobin levels, and stabilize white blood cell counts in animals facing oxidative stress (Akinmoladun *et al*., 2020). The plant also has immunomodulatory effects that help maintain a healthy blood balance by influencing cytokine production and supporting bone marrow function (Choudhary *et al*., 2014). When it comes to diazinon-induced toxicity, Aloe vera appears to play a dual protective role—first, by reducing oxidative stress with its antioxidant properties, and second, by helping to restore normal blood function, which improves the overall health of the organism. Albino rats (*Rattus norvegicus*) are considered a prime model for toxicology studies because they closely resemble humans in terms of genetics, physiology, and metabolism. Experimental research on diazinon has shown significant disruptions in blood health, such as decreased red blood cell counts and hemoglobin levels, along with shifts in white blood cell and platelet counts (Sharma & Goyal, 2014). These findings stress the need to explore natural therapeutic options like Aloe vera that could help mitigate these adverse effects. The exploration Aloe vera's ability to guard against diazinon-induced hematotoxicity is part of a larger scientific movement aimed at finding eco-friendly and naturally sourced substitutes for synthetic antidotes. Unlike the usual antidotes for organophosphate poisoning, which can have drawbacks or unwanted side effects, Aloe vera presents a more comprehensive method for reducing toxicity, thanks to its variety of bioactive components. By including it in toxicological strategies, we might not only protect blood health but also help ease the overall damage caused by pesticides.

Diazinon: Chemistry, Applications, and Toxicity

Diazinon, also known as O, O-diethyl O-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] phosphorothioate, is a popular synthetic insecticide that belongs to the organophosphate family, specifically the phosphorothioate group. This chemical was first introduced in 1952 by Ciba-Geigy, which is now known as Syngenta, and it's used widely as a broad-spectrum pesticide in both farming and home settings (Kegley *et al*., 2010). Structurally, diazinon has a phosphorothioate component that is quite lipophilic, which helps it to easily penetrate biological membranes and exert its powerful insecticidal properties. The way it works primarily involves inhibiting acetylcholinesterase (AChE), an important enzyme that breaks down acetylcholine at cholinergic synapses (Costa, 2018).



In the world of agriculture, diazinon has been widely used to tackle various pests that affect soil, plants, and even our homes. This includes pesky critters like aphids, leafhoppers, fruit flies, cockroaches, and fleas (EPA, 2006). It's also been utilized in livestock facilities to help manage ectoparasites. However, with increasing concerns about its impact on health and the environment, many countries, including the United States, have placed restrictions or outright bans on its use in residential areas, although it can still be used in agriculture under strict regulations (Jokanović, 2018). The toxicological importance of diazinon comes from how it transforms in

mammals. After exposure, diazinon is metabolized in the liver by cytochrome P_{450} enzymes, turning into diazoxon, which is a more powerful metabolite that inhibits acetylcholinesterase more effectively (Buratti *et al*., 2002). This leads to an excessive buildup of acetylcholine at synaptic junctions, causing overstimulation of both muscarinic and nicotinic receptors. The symptoms can include salivation, muscle tremors, respiratory issues, convulsions, and in severe cases, even death (Eddleston *et al*., 2008). In addition to causing neurotoxicity, diazinon leads to oxidative stress and alters important hematological and biochemical parameters. Studies have found that exposure can result in anemia, an increase in white blood cells, and compromised liver and kidney functions due to oxidative damage to cellular macromolecules (Sharma & Goyal, 2014). Prolonged exposure, even at low levels, has also been linked to endocrine disruption, reproductive challenges, and possible cancer risks (Mnif *et al*., 2011). Its persistence in soil and water raises significant ecological concerns, as it can accumulate in non-target organisms and disrupt aquatic ecosystems (Kumar *et al*., 2019).

Hematological Alterations Induced By Diazinon

Diazinon is a commonly used organophosphate pesticide that can negatively impact both the nervous system and blood parameters, which are important indicators of pesticide exposure. While its main action is to inhibit acetylcholinesterase, diazinon also causes oxidative stress and interferes with blood cell production, leading to variations in blood cell counts and hemoglobin levels (Sharma & Goyal, 2014). Studies conducted on albino rats and other animal models have consistently revealed that diazinon exposure can lead to anemia. This condition is defined by a decrease in red blood cell (RBC) count, hemoglobin (Hb) concentration, and hematocrit (Hct) values. This decline is thought to result from oxidative damage to the membranes of erythrocytes and a disruption in the synthesis of hemoglobin (Kalender *et al*., 2007). Additionally, there are notable changes in leukocyte profiles, including leukocytosis and neutrophilia, which indicate an immune response to the tissue injury and inflammation caused by the pesticide (Abdel-Rahman *et al*., 2001). Additionally, exposure to diazinon can lead to an increase in platelet counts, resulting in thrombocytosis. This might indicate that the bone marrow is being stimulated or that there's some compensatory blood cell production happening due to toxic stress (El-Sayed *et al*., 2011). These changes in blood health could hinder oxygen transport, weaken the immune system, and disrupt normal blood clotting. Prolonged exposure to low doses can also result in cumulative damage to blood cells, which raises concerns in both workplace and environmental contexts (Jokanović, 2018).

Aloe Vera: Phytochemistry and Pharmacological Properties

1. Phytochemistry

•Polysaccharides and Glycoproteins:

Aloe vera gel is packed with polysaccharides, mainly acemannan, glucomannan, and mannose-6-phosphate. These compounds are what give aloe its amazing abilities to modulate the immune system, heal wounds, and reduce inflammation (Hamman, 2008). Essentially, these bioactive sugars serve as biological response modifiers, enhancing how cells communicate with each other.

•Anthraquinones and Phenolic Compounds:

Compounds such as aloin, aloe-emodin, and barbaloin are known for their impressive antioxidant, antimicrobial, and laxative effects (Reynolds & Dweck, 1999). These secondary metabolites also play a role in protecting the liver and fighting cancer.

•Vitamins and Minerals:

Aloe vera is packed with essential vitamins like A, C, and E, which are powerful antioxidants, along with B-complex vitamins, folic acid, and important trace minerals such as calcium, magnesium, zinc, and selenium. These nutrients are crucial for helping to protect our bodies from oxidative stress (Surjushe *et al*., 2008).

•Enzymes and Amino Acids:

Enzymes like catalase, peroxidase, and alkaline phosphatase play a crucial role in detoxification, while both essential and nonessential amino acids are key players in protein synthesis and tissue repair (Chowdhury *et al*., 2008).

The phytochemistry of Aloe vera showcases a wealth of compounds like polysaccharides, anthraquinones, vitamins, and enzymes. These components come together to deliver impressive antioxidant, anti-inflammatory, and protective effects within biological systems.

2. Pharmacological Properties

•Antioxidant and Anti-inflammatory Effects:

Aloe vera helps to neutralize free radicals and reducing inflammation. It achieves this by modulating cytokines and reactive oxygen species, ultimately safeguarding our essential organs from oxidative harm (Akinmoladun *et al*., 2020).

•Wound Healing and Tissue Regeneration:

Acemannan enhances the growth of fibroblasts and increases collagen production, which aids in wound contraction and the regeneration of skin (Chithra *et al*., 1998).

•Immunomodulatory and Antimicrobial Properties:

Aloe vera plays a key role in enhancing the immune response by stimulating macrophages and lymphocytes, while its anthraquinones provide antibacterial, antiviral, and antifungal benefits (Sahu *et al*., 2013).

•Hepatoprotective and Antidiabetic Effects:

Aloe vera plays a role in reducing lipid peroxidation in the liver and enhancing liver function. It also improves insulin sensitivity and helps lower hyperglycemia, which makes it a valuable tool for managing diabetes (Yagi & Takeo, 2003).

•Anticancer and Cytoprotective Activity:

Aloe-emodin promotes apoptosis in cancer cells, and acemannan supports chemotherapy by enhancing the immune system's ability to fight back (Samarghandian *et al*., 2017).

Aloe vera is known for its wide range of health benefits, from fighting off oxidative stress to modulating the immune system. This makes it a powerful natural remedy for dealing with chemical toxins and various metabolic issues.

Protective Effect of Aloe Vera on Hematological Parameters

Aloe vera, scientifically known as Aloe barbadensis Miller, has shown impressive protective benefits for blood-related parameters, especially when faced with toxic stress. Its active ingredients, like polysaccharides (acemannan), anthraquinones (aloin, aloe-emodin), vitamins, and flavonoids, play a key role in its antioxidant and immune-boosting properties (Hamman, 2008). These compounds help shield red and white blood cells from oxidative harm by neutralizing free radicals and lowering lipid peroxidation levels (Surjushe *et al*., 2008). Experimental studies on animals have demonstrated that Aloe vera can significantly reduce the blood toxicity caused by harmful substances like pesticides. It aids in restoring the counts of red blood cells (RBCs), hemoglobin (Hb), and hematocrit (Hct), while also preventing conditions such as leukocytopenia and thrombocytopenia that result from oxidative stress and bone marrow suppression (Akinmoladun *et al*., 2020). Moreover, Aloe vera's ability to modulate the immune system boosts lymphocyte proliferation and strengthens the overall immune defense (Sahu *et al*., 2013). When it comes to toxicity from pesticides, which can lead to anemia and affect white blood cell function due to oxidative imbalance, Aloe vera has been shown to help normalize blood parameters. This effect is attributed to its cytoprotective and antioxidant properties (Samarghandian *et al*., 2017). Thus, Aloe vera emerges as a valuable natural remedy for supporting blood health and alleviating chemical-induced hematotoxicity.

Future Prospectives

The protective benefits of Aloe vera against blood-related changes caused by toxic substances like diazinon really showcase its potential as a helpful therapeutic option. That said, future studies should aim to clarify the specific molecular pathways through which Aloe vera provides its protective effects on blood health. For example, research looking into how gene expression shifts in response to oxidative stress and blood cell formation could offer valuable insights (Nabavi *et al*., 2015). It's also essential to standardize Aloe vera extracts regarding their active compounds, dosages, and formulations to guarantee consistent effectiveness and safety (Akinmoladun *et al*., 2020). It's essential to conduct long-term toxicological and clinical studies to really confirm how effective Aloe vera is for humans who have been exposed to pesticides and other environmental toxins (Hamman, 2008). Using nanotechnology-based delivery systems could enhance the bioavailability of its active compounds, which might improve protective outcomes (Das & Sharangi, 2018). Plus, combining Aloe vera with other medicinal plants in polyherbal formulations could lead to exciting new options for synergistic hematoprotective therapies.

Conclusion

Diazinon is a widely used organophosphate pesticide that effectively tackles a variety of agricultural and household pests. However, its heavy usage comes with significant health risks, primarily because it can inhibit acetylcholinesterase. This inhibition leads to overstimulation of the nervous system, oxidative stress, and disruptions in blood parameters. When people are exposed to diazinon, they may experience issues like anemia, leukocytosis, thrombocytosis, and other blood-related disorders, which can weaken the immune system and throw off the body's overall balance. Therefore, changes in blood health are crucial indicators of toxicity caused by pesticides. On the bright side, Aloe vera (Aloe barbadensis Miller) has shown great promise in countering these negative effects. Packed with polysaccharides, flavonoids, anthraquinones, vitamins, and enzymes, Aloe vera boasts antioxidant, anti-inflammatory, immunomodulatory, and cytoprotective benefits. Research has shown that it can help restore red blood cell counts, hemoglobin levels, and hematocrit, while also normalizing white blood cell and platelet counts. Its ability to modulate the immune system further supports bone marrow function and boosts overall immune defense. Aloe vera's role as a natural protector against diazinon-induced hematotoxicity presents a sustainable and safe alternative to synthetic treatments. By focusing future research on its molecular mechanisms, standardizing extracts, and assessing long-term effectiveness, we could

establish Aloe vera as a dependable therapeutic choice for safeguarding hematological health in organisms that encounter chemical toxins.

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