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EFFECT OF RICE STRAW BURNING EXPOSURE ON HEMATOLOGICAL PARAMETERS OF ALBINO RAT AND ITS AMELIORATION WITH HONEY SUPPLEMENTATION

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ABSTRACT

Hematological parameters in albino rats, like in most mammals, provide crucial insights into their overall health and physiological status. These parameters include Total Erythrocyte Count (TEC) count, Total Leucocyte Count (TLC) count, Hemoglobin concentration, packed cell volume (PCV). In albino rats, these parameters may vary slightly from those of pigmented rats due to genetic differences. Understanding these parameters in albino rats is essential for biomedical research, as they serve as indicators of various physiological processes, including oxygen transport, immune function, and overall hematopoietic health. Accurate measurement and interpretation of these parameters are fundamental in assessing the impact of experimental treatments or genetic modifications on hematological function in albino rat models. Rice straw burning, a common agricultural practice in many parts of the world, poses significant environmental and health hazards. Furthermore, the practice of burning rice straw depletes soil nutrients and contributes to soil degradation, impacting agricultural productivity and sustainability in the long run. Effective alternatives to rice straw burning, such as incorporating straw into the soil or using it for bioenergy production, are essential for mitigating these harmful effects and promoting environmental and human health. Honey, a natural substance produced by bees from flower nectar, has been recognized for its diverse therapeutic properties, including its hematoprotective effects. Research suggests that honey contains various bioactive compounds such as antioxidants, flavonoids, phenolic acids, and enzymes, which contribute to its hematoprotective properties. These compounds scavenge free radicals and reduce oxidative stress, thereby protecting blood cells, including red blood cells (RBCs) and white blood cells (WBCs), from damage caused by reactive oxygen species (ROS). Honey has also been found to stimulate hematopoiesis, the process of blood cell formation, by promoting the proliferation and differentiation of hematopoietic stem cells in the bone marrow. The present study states that honey has potent hematoprotective effect in rice straw smoke

INTRODUCTION

Albino rats are widely used as model laboratory organisms due to their genetic uniformity, ease of handling, and well-documented physiology. Their white fur and red eyes, resulting from a lack of melanin, make them visually distinctive. Researchers favor albino rats for studies in toxicology, pharmacology, and behavioral science because they offer consistent results across experiments. Their relatively short lifespan and rapid reproductive rate enable multi-generational studies within a reasonable timeframe. Furthermore, albino rats' susceptibility to certain diseases mirrors human conditions, providing valuable insights into disease mechanisms and potential treatments. Overall, they are indispensable in advancing biomedical research(Wintrobe, 1981). Rice straw smoke poses significant health risks to animals due to its high levels of particulate matter and toxic compounds. Inhalation of this smoke can lead to respiratory issues, including inflammation, bronchitis, and chronic obstructive pulmonary disease (Liu *et al.* 2013). The presence of harmful chemicals like carbon monoxide and polycyclic aromatic hydrocarbons can cause oxidative stress, damaging tissues and impairing immune function. Prolonged exposure may result in reduced growth rates, reproductive issues, and increased susceptibility to infections (Hanafi *et al.* 2012). Additionally, the environmental impact of rice straw burning, such as habitat degradation, exacerbates the harm to wildlife, disrupting ecosystems and food sources. Overall, rice straw smoke is a serious environmental and animal health concern. Honey has remarkable healing effects on blood due to its natural antioxidant, anti-inflammatory, and antimicrobial properties(Zumla and Lulat, 1989). Rich in phenolic compounds, honey helps reduce oxidative stress, protecting blood cells from damage. It can lower inflammation, improving overall vascular health. Additionally, honey's natural sugars and enzymes support immune function, enhancing the body's ability to fight infections(Miguel *et al.* 2017). Its role in wound healing also extends to internal injuries, as it promotes tissue regeneration and reduces infection risk. Regular consumption of honey may aid in regulating blood sugar levels and improving lipid profiles, contributing to cardiovascular health(Abd *et al.* 2012). Thus, honey serves as a potent natural remedy for various blood-related ailments.

MATERIAL AND METHODS

The male albino rats (*Rattus norvegicus*) of wistar strain weighing between 120±25g were obtained from the colony of albino rats bred in the anima house of Zoology Department, School of Life Sciences, Khandari Campus, Agra were used for experimental purpose. The albino rats were housed in polypropylene cages measuring 45x25x15cm and maintained at controlled temperature of 25±2^{0}C, humidity 65±10% and proper circadian rhythm. The

acclimatized animals were divided into different groups as per protocol for 7, 15, 30, 45 and 60 days experiment including control set, honey feed set, rice straw smoke exposure set, honey feed+rice straw smoke exposure set and caged separately. They were maintained on standard diet- Goldmohar brand feed and water *ad libitum*.

The rice straw smoke was given to albino rats in gas chamber in laboratory for specific time period for 1 hr/day. The honeywas procured from local market. The selected therapeutic dose of honey was 250mg/kg body weight. All treatments of honey were given orally using a syringe and a bent tip canula. The doses were given for 7, 15, 30, 45 and 60 days respectively. The albino rats of all the groups were sacrificed under light anesthesia.

The hematological parameters were estimated through standard procedures and protocols viz. total erythrocyte count, total leucocyte count, hemoglobin concentration and packed cell volume (Wintrobe, 1981).

STATISTICAL ANALYSIS

All the data were subjected to statistical analysis through software Ky plot version 3.0.

RESULTS AND DISCUSSION

The results show significant changes with rice straw smoke exposure from control. The toxic effect in liver is modulated by honey supplementation as shown in Tables and graphs below-

Table-1

Protective Effect of Honey on Hemoglobin Concentration (gm/dl) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Experimental Sets	7 days (Mean±S.Em.)	15 days (Mean±S.Em.)	30 days (Mean±S.Em.)	45 days (Mean±S.Em.)	60 days (Mean±S.Em.)
Control	14.12+.57	14.12+.57	14.12+.57	14.12+.57	14.12+.57
Honey	14.78+.49*	14.37+.46*	14.54+.57*	14.57+.55*	14.04+.54*
Rice Straw Smoke Exposure	13.52+.44**	11.66+.35**	9.225+.41***	7.67+.37****	9.3+.47***
Rice Straw Smoke Exposure + Honey	14.61+.42*	13.63+.50*	13.12+.46***	12.75+.44****	14.25+.49****

NS- Non-significant (p>0.05), *- Significant (p<0.05), **- Highly Significant (p<0.01), ***- Very Highly Significant (p<0.001)

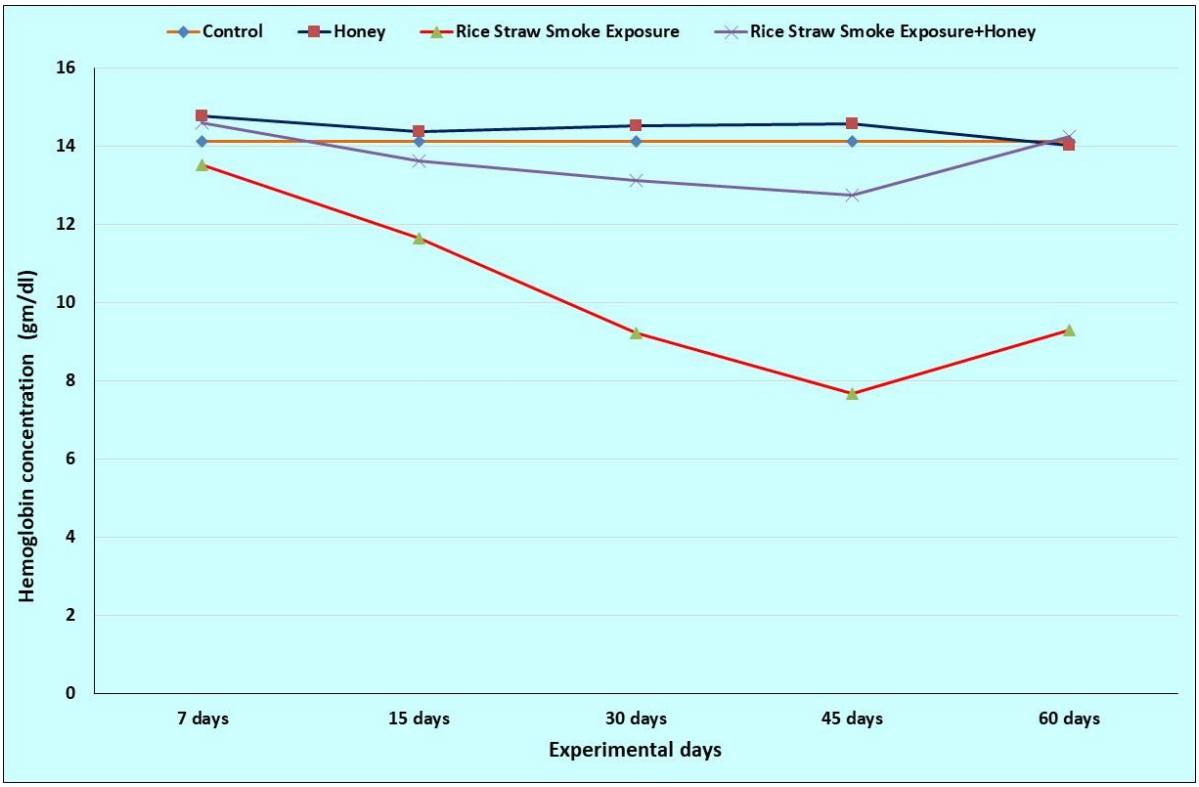

Fig-1

Protective Effect of Honey on Hemoglobin Concentration (gm/dl) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Table-2

Protective Effect of Honey on Total erythrocyte Count (million/cc) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Experimental Sets	7 days (Mean±S.Em.)	15 days (Mean±S.Em.)	30 days (Mean±S.Em.)	45 days (Mean±S.Em.)	60 days (Mean±S.Em.)
Control	7.82+.07	7.82+.07	7.82+.07	7.82+.07	7.82+.07
Honey	7.85+.42*	7.39+.49*	7.39+.50*	7.84+.30*	6.75+.59*
Rice Straw Smoke Exposure	6.02+.28**	4.74+.22****	3.84+.26****	3.50+.24****	5.60+.43***
Rice Straw Smoke Exposure + Honey	6.74+.42*	5.42+.29**	5.72+.32***	5.99+.26****	6.77+.37**

NS- Non-significant (p>0.05), *- Significant (p<0.05), **- Highly Significant (p<0.01), ***- Very Highly Significant (p<0.001)

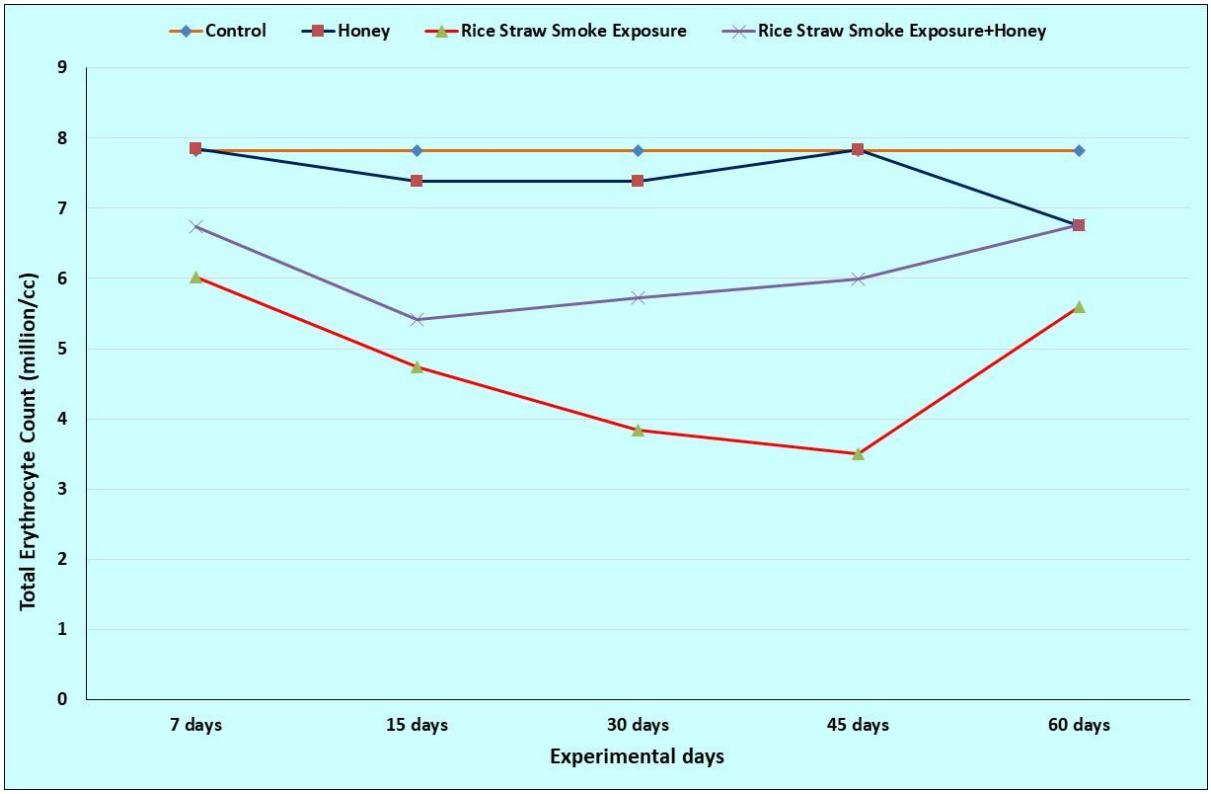

Fig-2

Protective Effect of Honey on Total erythrocyte Count (million/cc) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Table-3

Protective Effect of Honey on Total Leukocyte Count (thousand/cc) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Experimental Sets	7 days (Mean±S.Em.)	15 days (Mean±S.Em.)	30 days (Mean±S.Em.)	45 days (Mean±S.Em.)	60 days (Mean±S.Em.)
Control	5.55+.60	5.55+.60	5.55+.60	5.55+.60	5.55+.60
Honey	6.72+.65*	5.71+.57*	6.13+.67*	5.95+.68*	6.18+.70*
Rice Straw Smoke Exposure	9.46+.26***	9.35+.37***	11.82+.54****	6.81+.72*	7.76+.48*
Rice Straw Smoke Exposure + Honey	7.05+.50**	7.35+.51**	7.58+.41**	5.2+.59***	6.14+.65***

NS- Non-significant (p>0.05), *- Significant (p<0.05), **- Highly Significant (p<0.01), ***- Very Highly Significant (p<0.001)

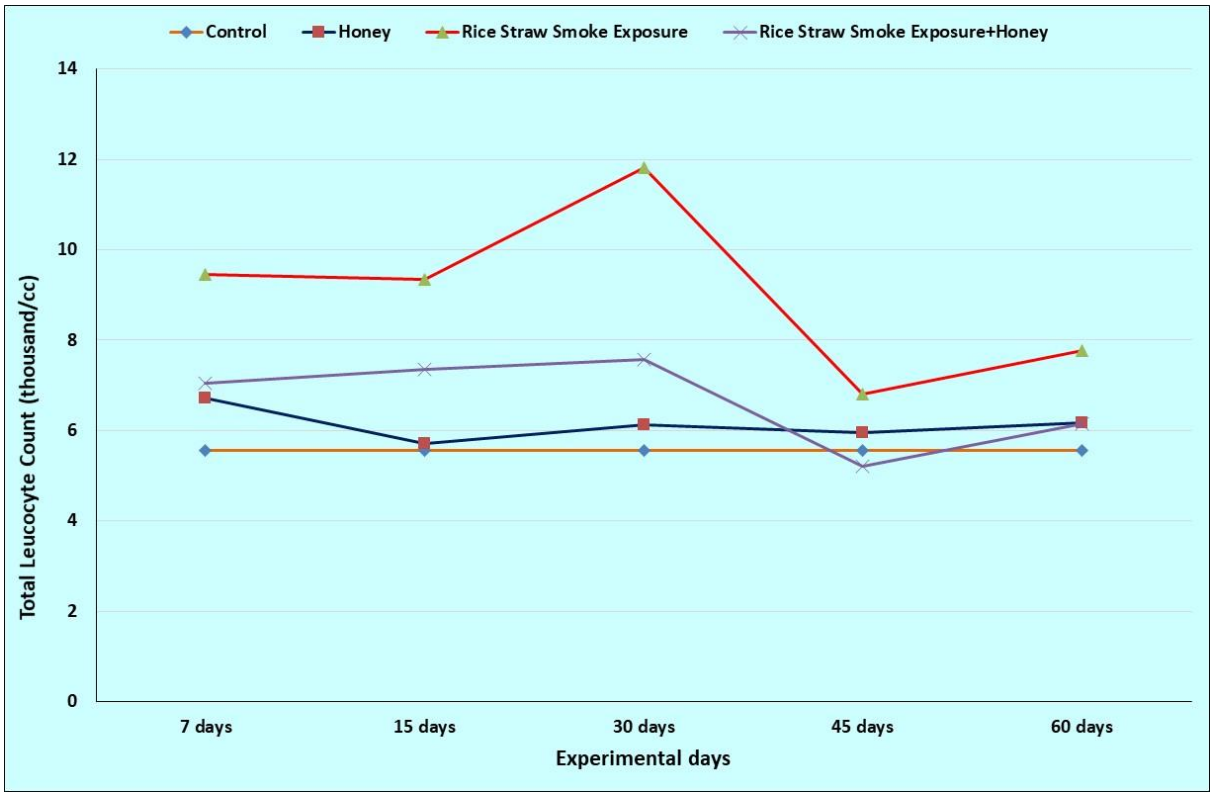

Fig.-3

Protective Effect of Honey on Total Leukocyte Count (thousand/cc) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Table-4

Protective Effect of Honey on Packed Cell Volume(%) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Experimental Sets	7 days (Mean±S.Em.)	15 days (Mean±S.Em.)	30 days (Mean±S.Em.)	45 days (Mean±S.Em.)	60 days (Mean±S.Em.)
Control	44.1+1.10	44.1+1.10	44.1+1.10	44.1+1.10	44.1+1.10
Honey	42.5+0.90*	43.2+0.99*	42.60+1.0*	44.2+0.95*	43.4+0.88*
Rice Straw Smoke Exposure	34.1+0.80***	32.50+0.90***	33.40+0.90***	30.50+0.67***	27.30+0.66****
Rice Straw Smoke Exposure + Honey	39.20+0.75**	41.20+0.50***	41.80+0.79***	42.70+0.80*****	43.90+0.95****

NS- Non-significant (p>0.05), *- Significant (p<0.05), **- Highly Significant (p<0.01), ***- Very Highly Significant (p<0.001)

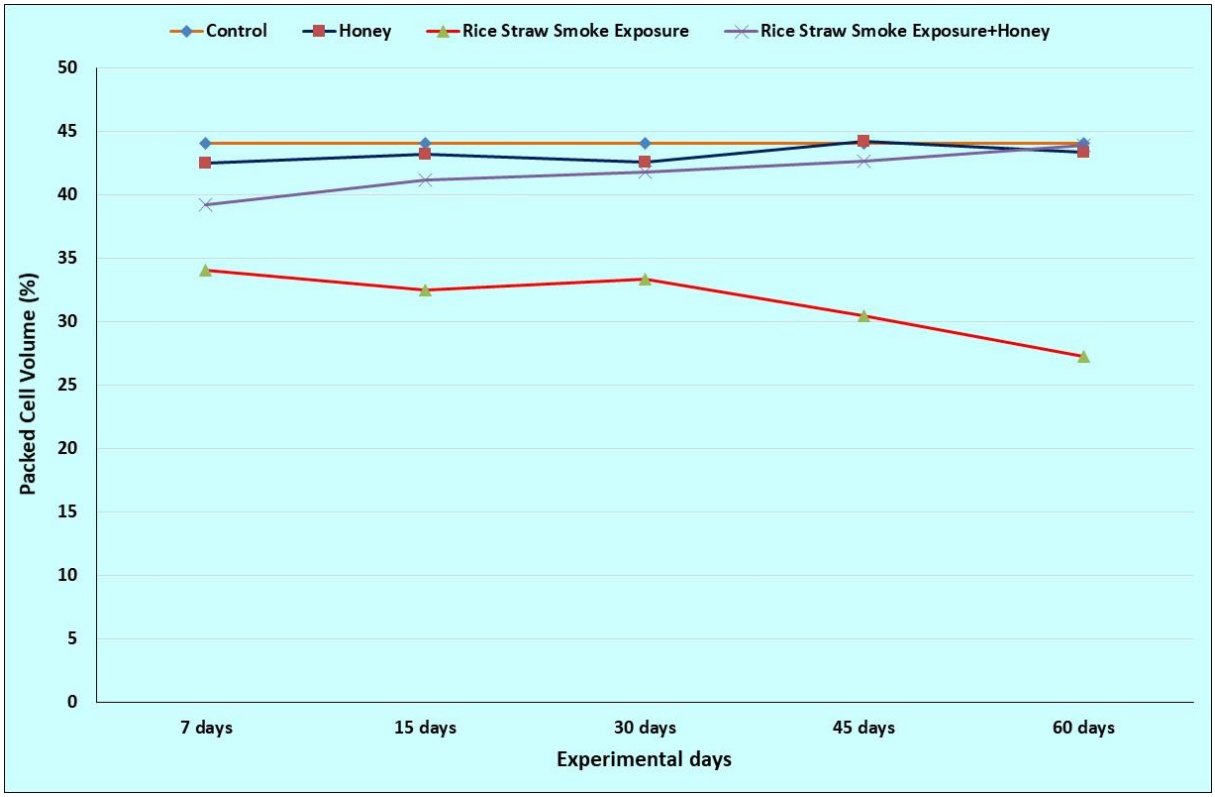

Fig.-4

Protective Effect of Honey on Packed Cell Volume (%) after Rice Straw Smoke Exposure for 7, 15, 30, 45 and 60 days in Albino rat

Estimating blood parameters in mammals is crucial for assessing overall health, diagnosing diseases, and monitoring treatment efficacy. Blood tests provide vital information about

organ function, nutritional status, and the presence of infections or diseases. Parameters such as red and white blood cell counts, hemoglobin levels, and electrolyte balance are essential indicators of physiological and pathological conditions. For instance, variations in glucose levels can indicate diabetes, while abnormal liver enzymes may suggest hepatic issues. Regular blood parameter assessments enable early detection of health problems, guiding timely interventions and improving prognosis. In research, these measurements are key to understanding disease mechanisms and evaluating the impact of experimental treatments (Wintrobe, 1981).

Rice straw smoke contains fine particulate matter (PM2.5 and PM10). These particles penetrate deep into the respiratory tract, causing inflammation, oxidative stress, and tissue damage in the lungs. Chronic exposure can lead to conditions like bronchitis, asthma, and even lung cancer (Liu *et al.* 2013). The smoke releases toxic chemicals, including carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic compounds (VOCs). CO binds with hemoglobin more effectively than oxygen, reducing oxygen delivery to tissues, causing hypoxia. NOx and VOCs contribute to respiratory and cardiovascular diseases (Hanafi *et al.* 2012). The smoke generates reactive oxygen species (ROS), causing oxidative stress. This damages cellular components like lipids, proteins, and DNA, leading to inflammation and cellular dysfunction. Rice straw smoke contains high levels of CO, which binds to hemoglobin in RBCs with much greater affinity than oxygen. This binding forms carboxyhemoglobin, reducing the oxygen-carrying capacity of the blood and leading to tissue hypoxia. Chronic exposure to CO can cause headaches, dizziness, and in severe cases, cardiovascular problems. Toxic chemicals in the smoke can trigger an inflammatory response, releasing cytokines that can affect bone marrow function. This inflammation can alter the production and maturation of blood cells, potentially leading to conditions like anemia or leukopenia (reduced white blood cell count). Prolonged exposure to the toxins in rice straw smoke can suppress bone marrow activity (Upadhyay 2023). This suppression impairs the production of RBCs, white blood cells, and platelets, leading to pancytopenia—a condition characterized by the reduction of all types of blood cells. Inhalation of rice straw smoke introduces reactive oxygen species (ROS) into the bloodstream. These ROS cause oxidative damage to blood cells, particularly red blood cells (RBCs), leading to hemolysis (destruction of RBCs). This oxidative stress also impairs the function of white blood cells, weakening the immune response (Watanabe *et al.* 2014).

Honey can support liver function, which is essential for detoxifying harmful substances from the body. A well-functioning liver helps in processing and eliminating toxins, thereby

reducing their hematotoxic effects. Regular consumption of honey can help in stabilizing blood parameters, including RBC count, hemoglobin levels, and white blood cell count (Ahmad *et al.* 2017). This stabilization is crucial in maintaining normal blood function and mitigating the adverse effects of toxic exposures. The antioxidant properties of honey help protect hemoglobin from oxidative damage. This is particularly important in preventing conditions like hemolysis, where RBCs are destroyed due to oxidative stress, reducing the oxygen-carrying capacity of the blood (Aliyu *et al.* 2013). Honey enhances the immune system through its antimicrobial properties and by promoting the activity of white blood cells. This helps in preventing infections and maintaining overall immune health, which is vital when the body is exposed to toxic substances that can suppress immune function (Basa *et al.* 2016; Ononye*et al.* 2022). Honey contains high levels of phenolic acids, flavonoids, and other antioxidants that neutralize reactive oxygen species (ROS). By reducing oxidative stress, honey helps protect red blood cells (RBCs) and other blood components from oxidative damage, which is crucial in counteracting the effects of hematotoxic agents like rice straw smoke (Muhammad *et al.* 2016; Chijiokwu*et al.* 2023). The anti-inflammatory compounds in honey, such as flavonoids and phenolic acids, reduce inflammation in the blood and bone marrow. This helps in maintaining healthy blood cell production and function, which can be compromised by toxic exposures (Mohamed *et al.* 2013; Khan *et al.* 2018).

CONCLUSION

From this investigation, it could be concluded that the honey is beneficial in the medicinal perspective against the potent toxic stress of rice straw burning by ameliorating its free radical nature and neutralizing ROS. This study will help the society to know about the rice straw burning toxicity and how to minimize or ameliorate with honey.

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