



Research Article

Effect of *Boletus edulis* on Haematological Parameters in Wistar Rats

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Received Date: 15 Sept. 2025

Published Date: 27 Oct. 2025

Abstract

The research examined the impact of *Boletus edulis* (mushroom) on haematological markers in Wistar rats. *B. edulis* is an edible fungus that contains a lot of bioactive substances, such as polysaccharides, phenolics, flavonoids, and ergosterols, which are known for their antioxidant and immunomodulatory effects. Twenty-four adult Wistar rats were segregated into four groups of six: one control group receiving distilled water and three experimental groups (B, C, and D) supplied 40 mg/kg, 80 mg/kg, and 120 mg/kg of body weight of *B. edulis* aqueous extract daily for 28 days. We looked at the packed cell volume (PCV), haemoglobin (Hb), red blood cell count (RBC), white blood cell count (WBC), and platelet count in blood samples taken from the heart. The results indicated a dose-dependent elevation in Hb, RBC, and PCV levels, alongside a significant enhancement in WBC and platelet counts relative to the control group ($p < 0.05$). The results indicate that *B. edulis* promotes erythropoiesis and immunological efficacy, likely attributable to its abundant antioxidant and nutritional profile. The mushroom could be a good natural way to boost blood flow and the immune system.

Keywords: *Boletus edulis*, haematological parameters, Wistar rats.

Introduction

Mushrooms have long been known to be good and useful for medicine because they are full of bioactive compounds. The king bolete or porcini mushroom, also known as *Boletus edulis*, is a very popular edible fungus that belongs to the Boletaceae family. It has a lot of different substances, such as phenolic acids, ergosterols, tocopherols, ascorbic acid, polysaccharides, and minerals that are good [1]. These components are recognised for their antioxidative, anti-inflammatory, and haematopoietic characteristics. *Boletus edulis* is an edible mushroom that bears soft, edible fruit bodies. One can see them on a dead tree or on the ground, where it can be picked up by hand. Many people eat it because it tastes good and they think it has health benefits [2]. This mushroom, *Boletus edulis*, has different amounts of protein and fibre. It also has selenium, an antioxidant, and B vitamins. So, it helps the immune system and protects cells and tissues from injury. Being in the sun raises their vitamin D levels [3]. *Boletus edulis* has been considered a therapeutic fungus in folk medicine for a long time, having several health benefits beyond its nutritional value. Recent pharmacological research have corroborated its traditional assertions, demonstrating that *B. edulis* exhibits significant antioxidant, anti-inflammatory, and anticancer properties. The bioactive components of the mushroom, including polysaccharides, phenolic compounds, tocopherols, and ergosterols, can get rid of reactive oxygen species (ROS) and protect cellular DNA from oxidative damage, which is a key element in the development of cancer. *B. edulis* protects DNA from damage by increasing the levels of antioxidant enzymes in the body, such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx). This lowers oxidative stress and lipid peroxidation [4]. By preserving genomic integrity, these chemicals assist in averting the onset of oncogenic alterations and may hinder cancer development and progression. Additionally, certain polysaccharides derived from *B. edulis* have exhibited immunomodulatory properties, augmenting macrophage activity and promoting lymphocyte proliferation two critical mechanisms in antitumour immune surveillance [5]. These results indicate that *B. edulis* may not only safeguard cells from mutagenesis damage but also directly impede

tumorigenesis by modulating molecular signalling pathways, including NF- κ B, PI3K/Akt, and MAPK [6]. These combined protective and inhibitory effects underscore its promise as a natural adjuvant in cancer prevention and therapy techniques. Additionally, new research suggests that *B. edulis* may help protect the brain and treat neurodegenerative diseases like Alzheimer's disease. In experimental models, the mushroom's phenolic and ergosterol fractions have been demonstrated to stop neuroinflammation, lower amyloid- β aggregation, and improve cholinergic neurotransmission [7]. *B. edulis* may help reduce brain damage caused by oxidative stress and mitochondrial dysfunction, which are important parts of how Alzheimer's disease starts. It does this by fighting inflammation and oxidative stress. Consequently, the medicinal significance of *Boletus edulis* transcends its nutritional attributes, including both chemopreventive and neuroprotective properties. Incorporating it into dietary and pharmaceutical applications may offer a comprehensive strategy for disease prevention, especially in contexts related to oxidative stress and inflammation [8]. *Boletus edulis* has been demonstrated to exhibit certain therapeutic characteristics that may aid in weight reduction in overweight adults, as well as phytonutrients that might inhibit cellular adhesion to vascular walls, hence preventing plaque accumulation. It can also make red blood cells. So, it helps the body make more blood. In the world of food, mushrooms are considered vegetables, however they aren't really plants. They are part of the kingdom of fungi. Mushrooms are not vegetables, but they do have a lot of critical nutrients [9]. Eating these mushrooms is the best way to make sure you get adequate vitamins and minerals. It talks about the health advantages of mushrooms in detail and how to eat more of them [10]. Some scientific studies have looked into using *Boletus edulis* to treat anaemia. These trials clearly showed that *Boletus edulis* could actually help with anaemia. Nonetheless, there is limited information about the significance of *Boletus edulis* in the management of anaemia [11]. Packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell count (RBC), white blood cell count (WBC), and platelet count are some of the most important blood tests for checking the health of an organism. These values are useful biomarkers for checking how well the blood is working and how well the haematopoietic system is working [12]. Blood is essential for transporting oxygen, delivering nutrients, defending the immune system, and maintaining homeostasis. Therefore, even little changes in these indices may suggest health problems or adaptations to physical stress. Changes in Hb concentration and PCV frequently indicate disturbances in erythropoiesis the synthesis of red blood cells or heightened erythrocyte breakdown, as observed in anaemia or haemolytic diseases. A decrease in these parameters may occur due to nutritional deficiencies (such as iron, folate, or vitamin B₁₂), bone marrow suppression, or chronic disease states. On the other hand, high amounts of RBC, Hb, and PCV may be a way for the body to make up for low oxygen levels, dehydration, or activation of erythropoietin [13].

The total white blood cell count (WBC) is a critical sign of how well the immune system works and shows how the body reacts to stress, infection, inflammation, or exposure to toxins. Leukocytosis, which means an increase in the number of white blood cells (WBCs), usually means that the immune system or an inflammatory process is going on. On the other hand, leukopenia, which means a decrease in the number of WBCs, could mean that the immune system is weak, the bone marrow is not working properly, or a serious systemic infection is going on [14]. By keeping an eye on WBC differentials, you can learn more about the immunological response that has been triggered. This can help you tell the difference between bacterial, viral, allergic, or parasite illnesses. In the same way, the number of platelets in the blood gives important information about the body's ability to stop bleeding and create blood clots. Thrombocytopenia (low platelet count) can make you more likely to have bleeding problems, whereas thrombocytosis (high platelet count) can make you more likely to have thromboembolic problems [7]. Platelets are also becoming more important in inflammation and immunity because they release cytokines and growth factors that change the activity of leukocytes and the health of blood vessels [15]. Due to their susceptibility to internal and external factors, haematological indices are frequently employed as biomarkers for food sufficiency, environmental stress, drug toxicity, and disease advancement in both experimental models and clinical studies [9]. In toxicological and nutritional investigations utilising laboratory animals, alterations in these parameters function as early and dependable indicators of the impact of test chemicals or dietary treatments on blood physiology [16]. Natural items, such as mushrooms, have recently garnered interest as viable alternatives to manufactured hematinics. Their bioactive substances might make bone marrow work harder, protect red blood cells from oxidative damage, and change how the immune system works. Nevertheless, there exists a paucity of scientific data regarding the haematological effects of *B. edulis*, especially in animal models [17]. This study assessed the impact of *Boletus edulis* extract on haematological parameters, including packed cell volume (PCV), haemoglobin (Hb), red blood cell count (RBC), white blood cell count (WBC), and platelet count in Wistar rats, elucidating its potential role as a natural haematinic supplement.

Materials and Methods

Sample Collection and Preparation of Extract

The *Boletus edulis* was obtained from Ekeonunwa Market in Owerri Imo State, Nigeria between 17th and 18th September, 2024. Fresh fruiting bodies of *Boletus edulis* were authenticated at the Department of Plant Science, Imo State University, Owerri, Nigeria.

Preparation of *Boletus Edulis*

The *Boletus edulis* was washed thoroughly to remove dust and sand particles. It was then sundried for seven days. The dried *Boletus edulis* was ground into powder form with an electric blender. About 300grams of the pulverized dried *Boletus*

edulis were macerated in distilled water for 48 hours with intermittent shaking. Then it was filtered using Whatman filter paper, and the rotary evaporator at 40°C. The extract was kept at 4°C in a refrigerator for further use.

Experiment Animals

Twenty-four apparently healthy adult male Wistar rats weighing between 100g to 120g were used for the study. They were kept in a clean plastic cage and housed in the experimental animal house of Imo State University. The Wistar rats were acclimatized for a period of 14 days, during which they were fed properly with commercially prepared grower mash made by Grand Cereals Ltd and distilled water was provided *ad libitum*. The study was approved by the institutional Ethical Committee.

Experimental Design

The animals were randomly assigned into four groups of six rats each. Each group was treated either with distilled water only or with single dose of variable doses of *Boletus edulis*. These are classified as follows; Group A is the control that was only administered with the rat diet. Group B, C and D were administered with extract of *Boletus edulis* with a dose concentration of (40mg/kg, 80mg/kg and 120mg/kg body weight) respectively for 28 days.

BLOOD COLLECTION: After treatment with *Boletus edulis* extract for 28 days, all the animals (Group A to D) were weighed and anaesthetized in a glass jar containing cotton wool soaked in chloroform. Blood samples were collected by Cardiac Puncture using sterile needle and syringe. The blood samples were put into EDTA containers properly labeled for analysis within 24 hours of collection.

Haematological parameters Assay: Haematological parameters (PCV, Hb, RBC, WBC, and platelet count) were determined using an automated hematology analyzer (Sysmex KX-21, Japan) following standard methods.

STATISTICAL ANALYSIS: All results were expressed as mean $\pm$ standard deviation. The data was analyzed using one-way analysis of variance (ANOVA) followed by student's t-test. $P < 0.05$ was considered as statistically significant.

Results

Effect of *Boletus edulis* on Haematological Parameters

Parameter	Control	40 mg/kg	80 mg/kg	120 mg/kg
Hb (g/dL)	11.7 $\pm$ 0.8	13.1 $\pm$ 0.5*	14.0 $\pm$ 0.7*	15.0 $\pm$ 0.6**
PCV (%)	35.8 $\pm$ 1.3	39.2 $\pm$ 1.1*	41.8 $\pm$ 1.2*	43.9 $\pm$ 0.7**
RBC ($\times 10^6/\mu\text{L}$)	5.66 $\pm$ 0.22	5.98 $\pm$ 0.32	6.71 $\pm$ 0.15*	6.84 $\pm$ 0.31**
WBC ($\times 10^3/\mu\text{L}$)	7.10 $\pm$ 0.41	7.98 $\pm$ 0.62	8.32 $\pm$ 0.61*	8.97 $\pm$ 0.91**
Platelet ($\times 10^5/\mu\text{L}$)	2.02 $\pm$ 0.20	2.21 $\pm$ 0.24	2.49 $\pm$ 0.28*	2.89 $\pm$ 0.27**

Discussion

The results of this study demonstrated that *Boletus edulis* extract markedly enhanced haemoglobin concentration, packed cell volume, and red blood cell count in Wistar rats in a dose-dependent fashion. This observation suggests that the mushroom contains active components that can stimulate erythropoiesis and keep red blood cells healthy. The rise in these values indicates augmented haemoglobin synthesis and expanded oxygen transport capacity of the blood, both of which are crucial for appropriate tissue oxygenation and overall physiological function. These findings align with the study by [18], which illustrated the haematinic properties of edible mushrooms in enhancing erythropoiesis due to their abundant micronutrient and antioxidant content. Mushrooms like *B. edulis* have important minerals such as iron, copper, and zinc. These minerals are needed by enzymes that are important for making haemoglobin and maturing red blood cells. Iron is a key ingredient of haemoglobin, and copper helps iron get into the body and move it from storage places, which makes sure that haemoglobin is made quickly. Folate, riboflavin, and vitamin B₁₂ found in *B. edulis* are also very important for making nucleic acids and for the growth of erythroblasts in the bone marrow [19]. The observed improvement of haematopoiesis may be ascribed to the mushroom's antioxidant and bioactive constituents, including ergosterol, phenolic acids, flavonoids, and polysaccharides. These phytoconstituents assist in neutralising reactive oxygen species (ROS) and safeguarding growing erythroid cells from oxidative stress, a principal factor in red cell membrane damage and premature haemolysis. *B. edulis* extract may improve the survival and turnover of red blood cells by stopping oxidative damage to erythrocyte membranes and keeping erythropoietin active. Additionally, polysaccharides derived from *Boletus edulis* have been documented to activate macrophages and induce the secretion of haematopoietic growth factors, including interleukin-3 (IL-3) and granulocyte-macrophage colony-stimulating factor (GM-CSF), which are essential for the proliferation and differentiation of erythroid progenitor cells. This immunostimulatory characteristic may indirectly facilitate erythropoiesis by establishing a conducive bone marrow milieu for red blood cell formation. Another possible reason for the rise in haematological indices seen in this study is that *B. edulis* may make iron more available. Mushrooms have organic acids and chelating compounds that might help the body absorb iron from food better and lessen the negative effects of phytates.

and oxalates [20]. This process may elucidate the increased haemoglobin and packed cell volume (PCV) values observed in the treated groups compared to the control. The results of this study confirm the historical application of *Boletus edulis* as a natural blood tonic and reinforce the accumulating evidence that edible mushrooms can function as effective nutraceuticals in the prevention or management of anaemia. The studies also indicate that frequent ingestion of *B. edulis* or its extracts may enhance erythropoietic activity and haemoglobin synthesis via synergistic interactions of its mineral and antioxidant components. The observed augmentation of erythropoiesis may be ascribed to the iron, copper, and folate content of *B. edulis*, which are crucial cofactors for haemoglobin production. Additionally, phenolic and polysaccharide components may safeguard erythrocyte membranes from oxidative stress, hence extending their longevity. An increase in white blood cells and platelets suggests that *B. edulis* may also help with making new white blood cells and platelets. This is probably because mushroom-derived β -glucans have immunomodulatory actions that can activate macrophages, lymphocytes, and bone marrow progenitor cells [21]. The extract caused a big, dose-dependent rise in all blood parameters compared to the control group, which shows that it had stronger effects on making red blood cells and boosting the immune system. These results show that *B. edulis* can make mammals' blood and immune systems stronger, which supports its usage as a natural blood tonic in traditional medicine.

Conclusion

Giving Wistar rats a dose-dependent amount of *Boletus edulis* aqueous extract considerably improved their blood parameters. The mushroom demonstrates significant haematinic and immunomodulatory effects, potentially facilitated by its bioactive micronutrients and antioxidants. So, *Boletus edulis* could be a good functional food or natural supplement for avoiding or treating anaemia and a weak immune system.

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