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Original Research Article

Hematological Effects of *Newbouldia laevis Leaf Extract* and Homeopathic Remedies in Streptozotocin-Induced Diabetic Rats

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ABSRTACT

The defining characteristic of diabetes mellitus, a chronic metabolic disease, is persistent hyperglycemia caused by insufficient insulin secretion, defective insulin action, or both. This study evaluated the hematological effects of *N. laevis* leaf extract and its homeopathic formulations in diabetic rats induced with streptozotocin. The homeopathic mother tincture was prepared by dissolving the plant extract in absolute ethanol and further diluting it to obtain various X and C potencies via the serial dilution and succussion methods. Diabetes was induced in the rats via a single intraperitoneal injection of streptozotocin (50 mg/kg). The rats were assigned to eleven groups, including normal and diabetic controls; a standard drug group (glibenclamide); three crude extract doses (200, 400, and 600 mg/kg); and five homeopathic potencies (1X, 2X, 3X, 6X, and 30C). Treatments were administered orally for 21 days, and hematological parameters were determined via standard methods. The results showed that the 600 mg/kg dose and 3X potency of *N. laevis* significantly restored RBC, hemoglobin, and PCV levels and normalized WBC and platelet counts, comparable to those of the standard drug. In contrast, the 6X and 30C groups showed minimal improvements, with hematological parameters remaining similar to those of the diabetic control. These findings suggest that *N. laevis* possesses dose-dependent hematopoietic and immunomodulatory properties and may serve as a promising adjunctive treatment for diabetes-related hematological disorders.

Keywords: *N. laevis,* Diabetes mellitus, Homeopathic potencies, Hematological parameters, Streptozotocin-induced rat

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Introduction

The prevalence of diabetes mellitus has increased significantly in recent years, making it a major public health concern globally.[1] Approximately four hundred and sixty-three million people worldwide have diabetes, with more than nineteen million individuals residing in Africa.[2] The cellular processes associated with the detection, release, and synthesis of insulin are closely controlled since these actions are necessary for ensuring the balance of glucose. Diabetes can result from abnormalities in any of the processes involved in these activities.[3] In addition to its metabolic implications, diabetes is also associated with significant hematological disturbances, including anemia, leukocytosis, and thrombocytosis, which contribute to the morbidity observed in diabetic patients. An animal's hematological characteristics serve as important indicators of its physiological status, and changes in these indicators are necessary for identifying how the animal reacts to different physiological conditions.[4] The erythrocyte membrane, ability of hemoglobin (Hgb) to bind oxygen, and mechanical properties are affected by hyperglycemia in red blood cells.[5] Patients with diabetes frequently have anemia, particularly those who have chronic kidney disease.[6] *Corresponding author.

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These changes are often driven by increased oxidative stress, chronic inflammation, impaired erythropoiesis, and alterations in hematopoietic growth factors.[7] A comprehensive nutritional/dietetic strategy using nutraceuticals that may control inflammation and associated oxidative stress may be able to protect against the onset of anemia or inflammation in the elderly population and its detrimental effects on patients' performance and quality of life, given the etiopathogenetic mechanisms of this condition.7 Recent interest has increased in exploring the therapeutic potential of plant-based agents with antioxidant and anti-inflammatory properties in mitigating these hematological disruptions. *N. laevis* is a medicinal plant that is traditionally used in African ethnomedicine. The plant genus *Newbouldia*, belonging to the Bignoniaceae family, is native to Africa.[8] This monotypic genus includes one species, *N. laevis*, also known as the border tree. The plant has demonstrated promising antidiabetic and hepatoprotective properties.[8,9] However, scientific data on the effects of homeopathic formulations of *N. laevis* on hematology under the influence of diabetes mellitus are scarce. This work examined the hematological impact of different doses and homeopathic potencies of the leaf extract of *N. laevis* on diabetic rats induced with STZ over time. These findings provide insight into the potential of this plant as an adjunct or alternative therapy for the management of diabetes-related hematological complications.

Materials and Methods

Animals

The study involved fifty-five adult male Wistar rats (80–120 g) sourced from the Department of Zoology and Environmental Biology, University of Nigeria, Nsukka. All procedures complied with IACUC guidelines for laboratory animal care (ICMR, 2001).

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Plant material
N. laevis leaves were collected from Agulu, Anambra State, and authentication was performed by Dr. C.F. Iroka, a taxonomist from the Botany Department, Nnamdi Azikiwe University, Awka, Nigeria.

Plant extraction
The extraction process involved washing *N. laevis* leaves, shade drying them for seven days, and grinding them into a coarse powder. This powder was cold-macerated in ethanol (1:1) for 48 h. The filtrate obtained was then concentrated at 40 °C via a rotary evaporator and subsequently stored under refrigeration until needed.

Preparation of potentized homeopathic remedies
The potentiated homeopathic remedies were prepared as described by Rawat.[10]

Preparation of the homeopathic mother tincture
The *N. laevis* extract from homeopathic mothers was prepared by dissolving one part by weight of the *N. laevis* extract (4 mg) in 9 parts by weight (36 ml) of absolute ethanol (99.5% w/w) (Rawat, 2016).

Preparation of dilute ethanol
87% ethanol was prepared by adding one part distilled water to seven parts absolute ethanol.
The ethanol mixture (61%) was prepared by adding three parts distilled water to 7 parts 87% ethanol (Rawat, 2016).

Preparation of the homeopathic X potencies
The 1X potency was prepared by mixing one part of the homeopathic mother tincture with nine parts of dilute ethanol and then mixing it with the mixture. Subsequent potencies (2X to 6X) were made by serially diluting one part of the previous potency with nine parts ethanol. This process of serial dilution and succussion continued progressively up to 6X potency.

Preparation of the homeopathic C potencies
The 1C potency was prepared by diluting one part of the homeopathic mother tincture with 99 parts dilute ethanol, followed by 100 succussions. Each subsequent potency (2C to 30C) was prepared by serially diluting one part of the previous potency with 99 parts ethanol and then adding the mixture. This process was repeated up to the 30°C potency, with dilutions beyond 2°C likely containing few to no molecules of the original substance due to exceeding Avogadro's limit.

Induction of diabetes
Diabetes was induced in the rats via a single intraperitoneal injection of streptozotocin (50 mg/kg body weight) dissolved in cold citrate buffer (pH 4.5). The diabetic rats were randomly divided into 10 groups, each consisting of five rats. An additional control group of five nondiabetic, untreated rats was also included. Forty-eight hours later, blood samples were collected, and blood glucose levels were determined to confirm the development of diabetes.[11]

Experimental design
Fifty-five male albino rats were divided into eleven groups of five rats each. Group 1 was designated the normal control, while Group 2 was designated the diabetic control. In Group 3, glibenclamide was administered as a standard treatment. Groups 4 to 6 received 200, 400, or 600 mg/kg ethanolic crude extract, respectively. Groups 7 to 11 received homeopathic dilutions of the extract at potencies of 1X, 2X, 3X, 6X, and 30°C, which were administered as three oral drops every eight hours, and the study lasted 21 days.

Determination of hematological parameters
Packed cell volume, white blood cell count, red blood cell count, and hemoglobin concentration were determined via the method described by Ochei and Kolhatkar,[12] whereas platelet count was assessed via the procedure outlined by Baker and Silverton.[13]

Statistical analysis
The values are expressed as the means ± standard deviations. One-way analysis of variance (ANOVA) was performed via the Statistical Package for the Social Sciences (SPSS) to compare the means across the different groups.

Results and Discussion

Effect of N. laevis extract on red blood cell counts in diabetic rats over time
The effects of the *N. laevis* extract on the red blood cell (RBC) count of diabetes model rats over time are presented in Figure 1. The results of this investigation reveal the potential of the *N. laevis* extract in ameliorating RBC depletion associated with diabetes mellitus in experimental rats. Exposure to high glucose levels initiates a series of processes in these cells that result in structural, functional, and biochemical compositional changes.[14] This results in increased oxidative stress, impaired erythropoiesis, and glycation of hemoglobin.[15] The significant variation in RBC levels across the experimental groups over the periods of assessment highlights the impact of both the diabetic condition and the therapeutic interventions administered. At baseline, no significant differences ($p > 0.05$) in RBC levels were detected among the various groups. After diabetes induction, RBC levels varied, with the uninduced untreated group showing significantly higher RBC levels than the other groups did. The lower RBC counts in the induced group indicate the hematological burden of diabetes, likely due to oxidative damage to erythrocytes and reduced erythropoietin activity. This finding is in line with the findings of Azeez *et al*.[16,] who reported decreased RBC levels in diabetic rats.

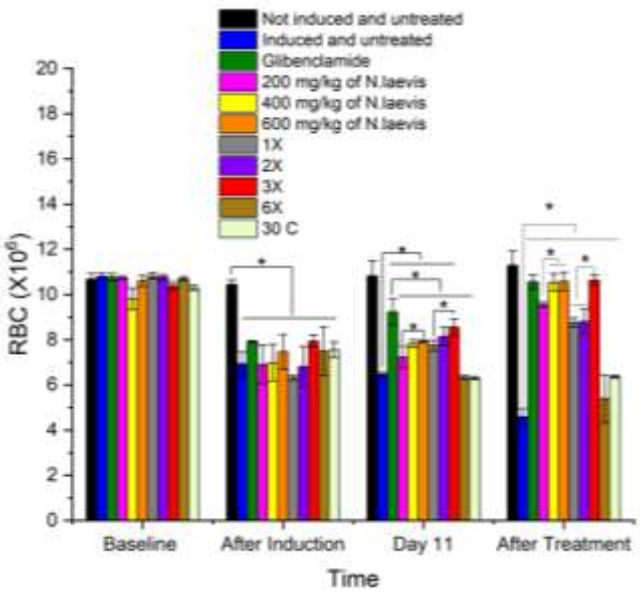

Figure 1: Effects of *N. laevis* extract on red blood cell counts in the induced and treated groups over time. The asterisk (*) indicates that the mean difference between groups was significant at $P < 0.05$.

By day 11 posttreatment, the uninduced untreated group presented significantly higher ($p < 0.05$) RBC levels than the other groups did. Additionally, the group that received the standard drug had significantly greater ($p < 0.05$) RBC values than did the induced untreated group and those treated with different doses of *N. laevis*. The induced untreated group, however, had lower ($p < 0.05$) RBC values, which were significant in comparison with those of most groups, apart from those of the groups treated with 6X and 30C, where no significant difference ($p > 0.05$) was detected. Furthermore, the difference ($p > 0.05$) observed between the RBC levels of the groups that received 200 mg/kg and 400 mg/kg was not significant. However, the group that received 400 mg/kg had significantly greater ($p < 0.05$) RBC values than did the 200 mg/kg group. Moreover, the difference ($p > 0.05$) between the RBC levels of

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the groups treated with 400 mg/kg and 600 mg/kg was not significant. The RBC levels of the groups treated with 6X and 30C were comparable to those of the induced untreated group, as the differences ($p > 0.05$) observed among them were not significant. However, all the other treatment groups presented significantly greater ($p < 0.05$) RBC values than did the groups that received 6X and 30C. Additionally, the difference ($p > 0.05$) between the RBC values of the 1X and 2X groups was not significant. Compared with all the other treatment groups, the 3X group presented significantly greater ($p < 0.05$) RBC values, with the exception of the 2X group, where the difference ($p > 0.05$) was not significant. These findings are supported by previous work demonstrating the antioxidant and antidiabetic properties of *N. laevis*, which may contribute to hematological improvements.[17]

After treatment, the RBC levels of the uninduced untreated group were comparable to those of the groups that received the standard drug (glibenclamide), 600 mg/kg, or the 3X dose, indicating that these treatments effectively restored RBC levels. In contrast, the induced untreated group had significantly lower ($p < 0.05$) RBC values than the other groups did. The differences ($p > 0.05$) in RBC values observed among the groups treated with 400 mg/kg/600 mg/kg and 3X were not significant. Similarly, the differences between the 1X group and the 200 mg/kg group and between the 1X and 2X groups were not significant. The significantly higher ($p < 0.05$) RBC counts in the uninduced untreated group throughout the study indicate the deleterious impact of hyperglycemia on erythropoiesis and reinforce the need for timely therapeutic intervention. The observation that the standard drug, high-dose *N. laevis extract* (600 mg/kg), and 3X preparations restored RBC levels to near-normal values shows the therapeutic potential of *N. laevis as* an alternative or adjunctive treatment for diabetes-related hematological disorders. The RBC counts of the groups treated with the 6X and 30C dilutions were similar to those of the diabetic control, suggesting that these concentrations may fall below the therapeutic threshold needed for hematological recovery.

Effect of N. laevis extract on hemoglobin levels in diabetic rats over time

The effects of the *N. laevis* extract on hemoglobin levels in diabetic rats over time are presented in Figure 2. Hemoglobin levels are critical indicators of overall health and the oxygen-carrying capacity of blood, and their variation can be linked to numerous pathological conditions, including diabetes mellitus.

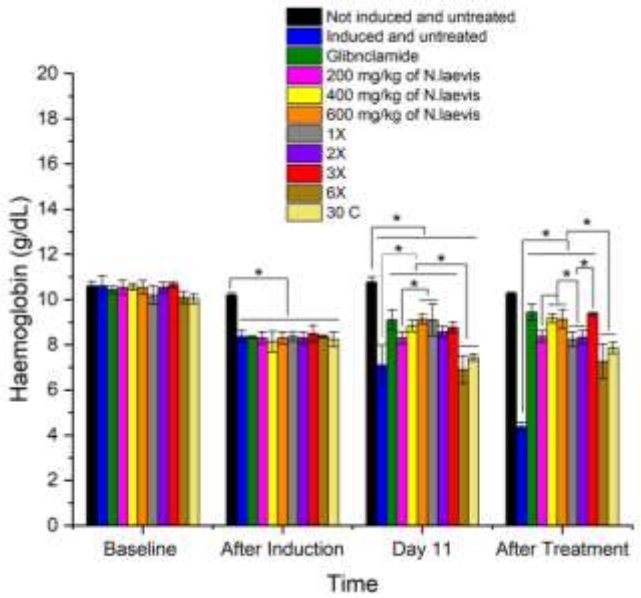

Figure 2: Effects of *N. laevis* extract on hemoglobin levels in the induced and treated groups over time. The asterisk (*) indicates that the mean difference between groups was significant at $P < 0.05$.

At baseline, the differences ($p > 0.05$) in the hemoglobin levels among the groups were not significant, indicating similar health statuses across all the animals. However, following the induction of diabetes, the uninduced untreated group had significantly higher ($p < 0.05$) hemoglobin levels than the other groups did, likely due to the absence of diabetes. The differences ($p > 0.05$) observed among the remaining groups postinduction were not significant. This finding is consistent with previous reports that hyperglycemia and diabetes are associated with a decrease in the hemoglobin concentration.[18] In DM patients, a low Hb concentration is associated with a rapid decrease in the glomerular filtration rate.[19] Low hemoglobin levels are more common in people with diabetic retinopathy and diabetic nephropathy.[20] This relationship raises the possibility that early intervention and management of renal problems may depend on hemoglobin level monitoring in diabetes patients. Additionally, treating anemia in these patients may enhance general kidney function and slow the development of associated disorders.

By day 11, the uninduced untreated group continued to exhibit higher ($p < 0.05$) hemoglobin levels, which were significant in comparison with those of all the other groups, whereas the induced untreated group presented significantly lower ($p < 0.05$) levels than the other groups did. Notably, the hemoglobin levels in the induced untreated group were not significantly different ($p > 0.05$) from those in the 6X and 30C groups, which also presented significantly lower ($p < 0.05$) hemoglobin levels than the remaining groups did. The differences ($p > 0.05$) in hemoglobin levels between the standard drug (glibenclamide) group and the groups treated with 400 mg/kg/600 mg/kg, 1X, 2X, or 3X were not significant. However, differences ($p < 0.05$) were significant when the standard drug was compared with the remaining groups. Compared with those in the 600 mg/kg and 1X groups, the hemoglobin levels in the 200 mg/kg groups were lower than those in the 600 mg/kg and 1X groups but were not significantly different ($p > 0.05$) from those in the 400 mg/kg, 2X, and 3X groups. Similarly, the hemoglobin levels in the 400 mg/kg group were not significantly different ($p > 0.05$) from those in the 200 mg/kg, 600 mg/kg, 1X, 2X, and 3X groups. Compared with those in the 400 mg/kg, 1X, 2X, and 3X groups, the values in the 600 mg/kg group were not significantly different ($p > 0.05$). Higher doses of *N. laevis* appear to provide more consistent protection against hemoglobin depletion, likely due to a greater concentration of bioactive compounds that can combat oxidative stress and support RBC synthesis.

After treatment, the induced untreated group still had significantly lower ($p < 0.05$) hemoglobin levels than the other groups did. Similarly, the groups treated with 6X and 30C presented significantly lower ($p < 0.05$) hemoglobin levels than did the other treatment groups. The differences ($p > 0.05$) in hemoglobin values between the standard drug group and the 400 mg/kg, 600 mg/kg, and 3X groups were not significant, whereas significant differences ($p < 0.05$) existed between the standard drug group and the remaining groups. Additionally, the differences ($p > 0.05$) between the 200 mg/kg group and the 1X and 2X groups were not significant, although these differences were significant ($p < 0.05$). The 400 mg/kg group was not significantly different from the 600 mg/kg and 3X groups but differed significantly ($p < 0.05$) from the other groups. This may be due to the potential of *N. laevis* extract as a viable therapeutic intervention for diabetes-related anemia.

Effect of N. laevis extract on packed cell volume in diabetic rats over time

The effect of the *N. laevis extract* on the percentage packed cell volume in diabetic rats over time is presented in Figure 3. PCV is a key hematological parameter that reflects the proportion of erythrocytes in the blood and serves as an indicator of anemia, hydration status, and oxygen-carrying capacity. Diabetes mellitus is associated with hematological alterations, including reduced PCV, due to increased oxidative stress, hemolysis, and impaired erythropoiesis. Very low hematocrit, hemoglobin, and red blood cell counts may be signs of anemia.[21]

At baseline, the differences ($p > 0.05$) in PCV values among the various groups were not significant. However, following diabetes induction, significantly lower ($p < 0.05$) PCV levels were observed in the diabetes-induced groups than in the uninduced untreated group, possibly because of increased red blood cell (RBC) destruction and reduced

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erythropoietin synthesis. This trend aligns with findings from previous studies demonstrating anemia as a common complication in diabetic conditions.[22]

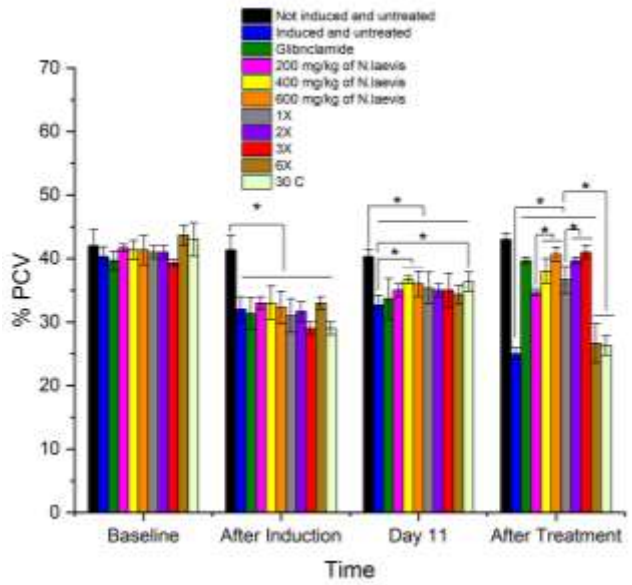

Figure 3: Effects of *N. laevis* extract on the percentage packed cell volume in the induced and treated groups over time. The asterisk (*) indicates that the mean difference between groups was significant at P < 0.05.

By day 11, the uninduced untreated group presented higher ($p < 0.05$) PCV values, which were significantly greater than those of the other groups. The induced untreated group, on the other hand, presented significantly lower ($p < 0.05$) PCV values than did the 400 mg/kg/600 mg/kg and 30 C groups but did not differ significantly ($p > 0.05$) from the remaining groups. Additionally, the differences ($p > 0.05$) observed in the PCV values among the groups treated with the standard drug, 200 mg/kg, 1X, 2X, 3X, 6X, and 30C were not significant. The 400 mg/kg/600 mg/kg groups also showed no significant differences ($p > 0.05$) from most of the other groups, except for the uninduced untreated and the induced untreated groups.

After treatment, the differences ($p > 0.05$) in PCV among the uninduced untreated group, the 600 mg/kg group, and the 3X group were not significant. However, the difference ($p < 0.05$) between all the other groups and the uninduced untreated group was significant. Compared with the other groups, the induced untreated, 6X, and 30C groups presented significantly lower ($p < 0.05$) PCV values. The 400 mg/kg group was significantly different ($p < 0.05$) from all the other groups except the 1X group ($p > 0.05$). Compared with the 200 mg/kg and 400 mg/kg groups, the 600 mg/kg group presented greater ($p < 0.05$) PCV values. Furthermore, the 2X and 3X groups presented significantly greater ($p < 0.05$) PCV values than did the 1X group. Compared with the 200 mg/kg and 400 mg/kg groups, the 1X group presented greater ($p < 0.05$) PCV values; however, the 600 mg/kg group presented significantly greater ($p < 0.05$) PCV values than did the 1X group. The significant variations observed between the treatment groups further highlighted the importance of dose optimization. The higher PCV levels in the 2X and 3X groups than in the 1X group suggest that intermediate dilution levels may offer increased hematological benefits. The 2X group was significantly greater than the 200 mg/kg group but did not differ significantly ($p > 0.05$) from the 400 mg/kg and 600 mg/kg groups. Finally, the 3X group presented higher ($p > 0.05$) PCV values than did the 200 mg/kg and 400 mg/kg groups but showed no difference ($p > 0.05$), which was significant compared with the 600 mg/kg group. The results of this study revealed that *N. laevis* extract has ameliorative effects on PCV in diabetic rats, with varying effects depending on the dose and duration of treatment. The lack of significant differences in ($p > 0.05$) PCV values between the 600 mg/kg group, the 3X group, and the uninduced untreated group suggest that *N. laevis* may serve as an effective adjunctive therapy for managing diabetes-associated anemia.

Effects of N. laevis extract on white blood cell counts in diabetic rats over time.

The effects of the *N. laevis* extract on the white blood cell (WBC) count in diabetic rats over time are presented in Figure 4. The WBC count is a critical hematological parameter that reflects the immune status and response to physiological or pathological stimuli.[23] In diabetes mellitus, the WBC count can be influenced by systemic inflammation, immune dysregulation, and oxidative stress resulting from chronic hyperglycemia.[24] The present findings demonstrate a dynamic interaction between diabetes induction, *N. laevis* treatment, and the WBC response over time. At baseline, the differences ($p > 0.05$) in WBC counts across all groups were not significant (Figure 8). The uniformity in WBC counts across all groups confirmed comparable physiological states before intervention. However, after induction, the uninduced untreated group presented significantly lower ($p < 0.05$) WBC counts than the other groups did, while no significant differences ($p > 0.05$) were observed among the other groups. This pattern suggests that an acute inflammatory response and leukocytosis are linked to diabetes-induced oxidative and immune stress. This finding is consistent with prior studies, which showed that diabetes elevates proinflammatory cytokine and WBC levels as part of the innate immune response.[25]

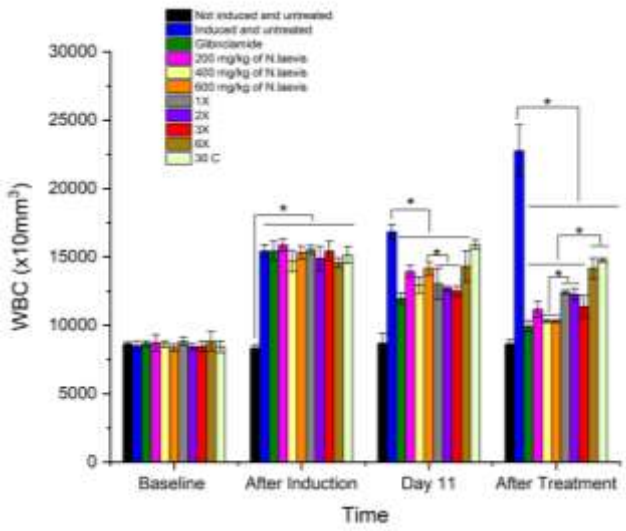

Figure 4: Effects of *N. laevis* extract on the percentage white blood cell count in the induced and treated groups over time. The asterisk (*) indicates that the mean difference between groups was significant at P < 0.05.

By day 11, the white blood cell (WBC) counts of the uninduced untreated group continued to decrease ($p < 0.05$), whereas those of the induced untreated group were significantly greater ($p < 0.05$). The differences ($p > 0.05$) observed between the standard drug group and the groups treated with 400 mg/kg, 1X, 2X, or 3X were not significant. However, the other treatment groups differed significantly from the standard drug group. Additionally, the WBC levels in the group treated with 200 mg/kg N. laevis were not significantly different ($p > 0.05$) from those in the 400 mg/kg, 600 mg/kg, and 1X *N. laevis* groups.

After treatment, the uninduced untreated group presented significantly lower WBC counts ($p < 0.05$) than the other groups did. The differences ($p > 0.05$) between the standard drug group and those treated with 400 mg/kg/600 mg/kg or the uninduced untreated groups were not significant, suggesting effective attenuation of the inflammatory response and restoration of the immune balance. These findings may be due to the immunomodulatory potential of *N. laevis*, possibly through its antioxidative and anti-inflammatory phytoconstituents. The 200

mg/kg group was not significantly different ($p > 0.05$) from the 400 mg/kg/600 mg/kg, 2X, and 3X groups, although it significantly differed ($p < 0.05$) from the other groups. The 400 mg/kg group did not differ significantly ($p > 0.05$) from the standard drug and 3X groups but was significantly different ($p < 0.05$) from the remaining treatment groups. Similarly, the 600 mg/kg group showed no difference ($p > 0.05$), which was significant compared with the standard drug, 200 mg/kg, standard drug, and 1X, 2X, and 3X groups, although its difference ($p < 0.05$) from the other groups was significant. However, the differences among the 1X, 2X, and 3X groups were not significant ($p > 0.05$). These results indicate that higher doses (400–600 mg/kg) and lower homeopathic dilutions (1X–3X) effectively mitigate the hyperinflammatory response induced by diabetes, making WBC counts comparable with those of healthy control animals and the standard drug group. These results show the immunomodulatory potential of *N. laevis*, possibly through its antioxidative and anti-inflammatory phytoconstituents. While the WBC values of the 6X and 30C groups were statistically similar ($p > 0.05$), both groups presented significantly greater ($p < 0.05$) WBC values than the other treatment groups did. The consistently higher WBC counts in the 6X and 30C groups, even after treatment, further confirmed their limited efficacy in reversing diabetes-induced inflammation. This may be due to excessive dilution of 6X and 30C, suggesting the need for critical assessment of dosage and formulations.

Effects of N. laevis extract and formulations on platelet levels in diabetic rats over time

The effects of the *N. laevis extract* on platelet levels in diabetic rats over time are illustrated in Figure 5. The platelet count is a sensitive hematological marker that reflects systemic inflammation, oxidative stress, and vascular damage, all of which are prominent in diabetes mellitus.[26] At baseline, the PLT did not differ significantly ($p > 0.05$) across the groups, confirming a uniform hematological status before diabetes induction. However, shortly after the induction of diabetes, the diabetic groups presented a significantly greater ($p < 0.05$) platelet count than did the nondiabetic group. These findings support previous reports that hyperglycemia triggers increased platelet production and activation, thereby increasing thrombotic risk and contributing to vascular complications in diabetic patients[27].

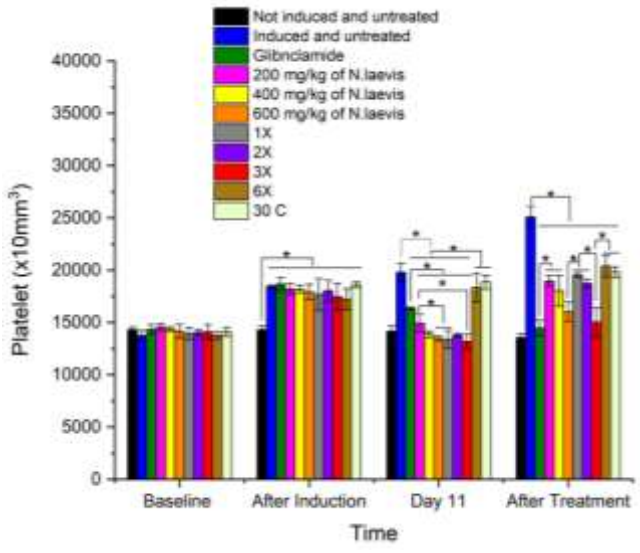

Figure 5: Effects of *N. laevis* extract on the platelet count in the induced and treated groups over time. The asterisk (*) indicates that the mean difference between groups is significant at $p < 0.05$.

By day 11, the differences ($p > 0.05$) in platelet levels between the uninduced untreated group and the groups treated with 200 mg/kg, 400 mg/kg, or 600 mg/kg, as well as the 1X, 2X, and 3X formulations, were not significant, suggesting that normalized platelet levels were not significantly different from those of the uninduced group. This normalization indicates a potential antithrombotic or anti-inflammatory effect of *N. laevis*, likely attributed to its known phytoconstituents, such as flavonoids and alkaloids, which possess antioxidative and membrane-stabilizing properties.[28] However, the 6X and 30C groups, along with the induced untreated group, presented persistently elevated platelet levels, supporting the idea that highly diluted homeopathic formulations and a lack of treatment do not alleviate diabetic hematological alterations.

Notably, the induced untreated group had significantly greater ($p < 0.05$) platelet counts than the other groups, with the exception of the 30 C group. Both the 6X and 30C treatments led to significantly ($p < 0.05$) elevated platelet counts relative to all the other treatment groups, although the difference ($p > 0.05$) between the two was not significant. Compared with the other treatment groups, the standard drug group presented higher platelet levels, except for the 6X and 30C groups, for which there was no significant difference ($p > 0.05$). Similarly, the differences ($p > 0.05$) in platelet counts observed among the groups treated with 200 mg/kg/400 mg/kg and 2X were not significant, although those of the other groups differed significantly from those of the 200 mg/kg group. No significant differences were noted among the 400 mg/kg/600 mg/kg, 1X, 2X, and 3X treatment groups.

After treatment, the untreated induced group retained significantly elevated platelet counts, indicating ongoing systemic stress and inflammation in patients with unmanaged diabetes. The difference between the untreated uninduced group ($p > 0.05$) and the standard drug group was not significant. Similarly, the difference between the 3X group and the standard drug group was significant ($p > 0.05$). Compared with all the other groups, the untreated induced group maintained a significantly greater ($p < 0.05$) platelet count. The differences ($p > 0.05$) observed among the 400 mg/kg, 1X, 2X, 3X, 6X, and 30C groups were not significant. Additionally, the 400 mg/kg group and 2X, as well as the 600 mg/kg group and 3X, showed no significant differences ($p > 0.05$). Comparisons among 1X, 2X, 6X, and 30C revealed no significant differences ($p > 0.05$), although 2X and 3X differed significantly ($p < 0.05$). Finally, the difference ($p > 0.05$) between the 6X and 30C groups was not significant.

Conclusion

N. laevis extract demonstrated significant hematological benefits in diabetic rats, particularly at relatively high doses and intermediate homeopathic potencies (1X–3X), by restoring RBC count, hemoglobin levels, and PCV and normalizing WBC and platelet counts. The limited efficacy observed with the 6X and 30C potencies highlights the importance of appropriate dosing and dilution levels in achieving therapeutic outcomes.

Conflict of interest

The authors declare no conflict of interest

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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