Research Article

Efficacy of Beetroot (*Beta vulgaris*) Juice Supplementation with Iron Sucrose in Treating Canine Anemia

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Abstract | Canine anemia is a hematological condition frequently affects female and younger dogs. Common symptoms include fatigue, pale gums, tongue, and inner eyelids, along with weakness and decreased appetite. Treatment varies based on the underlying cause and severity of anemia, and often includes extended iron supplementation, which may result in several side effects. As a result, natural remedies such as beetroot juice, known for its high content of iron, folate, and vitamin C, are gaining popularity due to their immune-boosting and anti-anemic benefits. The current experiment was carried out over a period of 35 days involving 25 anemic dogs categorized into 5 distinct anemic groups (n=5 for each group) to investigate the effects of beetroot juice and iron sucrose supplementation. Group 1, 2, 3, and 4 received treatment with both beetroot and iron supplements, whereas Group 5 was given only beetroot juice. The result indicated that on Day 1, there was a reduction in the values of RBC, Hb, WBC, HCT, and PLT across all groups. Furthermore, the combination of iron sucrose (kidifer) and beetroot juice led to a significant enhancement in hematological parameters, especially the Hb level by Day 35 in Group 1, Group 2, and Group 3, with the significance being assessed $p \leq 0.05$ using one-way ANOVA (Tukey's 1 Degree of Freedom Test). Ultimately, the combination of iron sucrose injection and beetroot juice may serve as an effective therapy for iron deficiency anemia in dogs, even with the constraint of a single-arm study.

Keywords | Canine, Anemia, Beetroot, Iron sucrose, Hemoglobin, Hematology

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INTRODUCTION

Anemia is a blood condition that commonly occurs due to underlying factors such as estrous cycle, pregnancy, nutritional deficiency, parasitic infestations and chronic diseases. Canine pets and working dogs are frequently found anemic. It has become a serious concern for veterinary practitioner. In dog, the common indicators of anemia generally consist of weakness, pale gums and mucous membranes (tongue and inner eyelids), reluctant to exercise, increased heart rate, rapid breathing and reduced appetite. Usually, all breeds and ages of dog are commonly affected by this disorder which possess a notable diagnostic and treatment challenge in veterinary practices for small animals. Timely identification, categorization, and correction of anemia in dogs significantly influence the clinical strategy and treatment results. Additionally, the clinical symptoms of anemia tend to be nonspecific, varying from parasitic infestations and nutritional shortages to autoimmune diseases and chronic conditions

that contribute to higher morbidity. In countries like Bangladesh where limited availability of advanced diagnostic resources and a lack of awareness among pet owners further hinder the effective treatment of anemia. Consequently, many affected dogs remain undiagnosed or inadequately treated, leading to chronic illness, poor prognosis, increased morbidity and even mortality rates and a declined animal welfare. Iron deficiency anemia is becoming increasingly common, affecting nearly one-third of the global population due to insufficient iron intake from food sources (Sunuwar *et al*., 2020). This nutritional deficiency in the blood is characterized by the inability of red blood cells to transport adequate oxygen to body tissues (Siagian *et al*., 2020). When hemoglobin and hematocrit levels drop below normal, it leads to negative health consequences (WHO, 2025).

Iron supplementation may be an effective way to address iron deficiency anemia. However, the use of iron as a remedy can induce oxidative stress, which has negative impacts on health. Therefore, to avoid the toxic effect of iron there is an alternative natural therapy of anemia treatment that is the use of herbal ingredient beetroot (*Beta vulgaris)* (Utami and Farida, 2022). Beets are a naturally occurring root vegetable abundant source of phytochemicals and bioactive substances such as betalains, flavonoids, and polyphenols, which contribute to its antioxidant, anti-inflammatory, and cytoprotective effects. It contains carbohydrates, proteins, fats, vitamin A, B, C, minerals (iron, calcium, phosphorus) and a higher water content (Askinah and Simamora, 2023; Januariana *et al*., 2024; Demitri *et al*., 2024). Beetroot, often referred to as table beet or garden beet, is recognized for its rich crimson color and earthy taste. It is a fantastic source of iron, folate, and vitamin C, which are crucial for maintaining blood health and supporting the production of red blood cells. The nitrates found in beetroot may enhance blood circulation and improve oxygen delivery. Furthermore, *Beta vulgaris* enhances the circulatory system and supports the formation of red blood cells as well as the concentration of hemoglobin. It helps to cure anemia because beets are rich in folic acid and vitamin B12 (Jaiswal *et al*., 2014). Previous studies stated that beetroots are good for heart health with antimicrobial and cytotoxic activity (Vulic *et al*., 2013; Rauha *et al*., 2000).

While numerous studies have assessed the effectiveness of beetroot in managing anemia in humans and experimental animals, there is still lack of research regarding its application in veterinary medicine, particularly concerning the treatment of anemia in dogs. In Bangladesh, there is no significant clinical trials investigating the potential of beetroot juice as a treatment option for canines suffering from anemia. This clinical trial conducted to fill the existing research gap by exploring the effects of iron supplementation alongside beetroot juice treating anemia in dogs. The study particularly examines important hematological factors such as Red Blood Cell (RBC) count, White Blood Cell (WBC) count, Hemoglobin (Hb) concentration, Hematocrit (HCT), and Platelet Count Test (PLT) to evaluate the effectiveness of this natural supplement along with iron sucrose in enhancing the blood health of affected canines. However, in this study only affected dogs have been taken into consideration. The prime objective is to identify and find out the efficacy of beet root and iron sucrose on anemic dog. Thereby there is no control group considered in experimental design.

MATERIALS AND METHODS

Materials

- Beetroots: Fresh, firm and smooth roots with bright red color were collected from the local market of Savar, Dhaka.
- Animals: 25 anemic dogs of 15 Labrador and 10 German Shepherd breed (13 female and 12 male) of different age group with an average body weight of 25 kg were treated under this clinical trial in a dog kennel at Savar, Dhaka from 21.09.2024 to 26.10.24. Anemia was diagnosed by Complete Blood Count (CBC) test.
- Clinical references and anemia severity: Group1 (Life Threatening): 3.3-5 g/dl, Group2 (Severe): 5.5-6.6 g/dl, Group3 (Moderate): 7-7.87 g/dl, Group4 (Mild): 8-8.6 g/dl, Group5 (subclinical): 3.9-7.2 g/dl;
- Chemicals: Iron Sucrose (kidifer) IV injection purchased from General Pharmaceuticals Ltd. Bangladesh and Iron Capsule (Zeefol-CI) purchased from Eskayef Pharmaceuticals Ltd.

Experimental animals

25 anemic dogs of Labrador and German shepherd breeds (13 female and 12 male) from one kennel were considered for this study. The animals were reared in a commercial kennel client owned farm and they were handled carefully according to Bangladesh Veterinary Council's animal welfare act and housed properly on ventilated metallic cages. Animals were given standard dog diet and water ad libitum and exposed to 12/12 hours light/dark cycle at 28.0±2°C.

Preparation of beetroots juice

The red beetroots were washed under running water and carefully scrubbed by hand to eliminate dirt. Then these were peeled out and cut into slices. The small pieces were macerated using a "Walton blender and juicer model WBL-HM350" juice maker. After juice extraction it was filtered and stored in a refrigerator at 4 °C to minimize batch-to-batch variability; doses were administered volumetrically using calibrated syringes.

Preparation of medicine

3mg/kg iron sucrose with 100ml 0.9% w/v NaCl solution was prepared for I/V injection. Iron capsule was kept as it is.

Experimental design

The study was designed as single arm, open label exploratory clinical trial to assess the effects of beet root juice along with iron sucrose and iron capsule supplements on varying severity of affected anemic dogs. The 25 dogs were categorized into 5 groups (n=5) as per the severity of anemia within the total sample. A control group was not included in this study because all selected animals were naturally anemic and required therapeutic treatment. For ethical reasons, it was not allowed to deny treatment to anemic animals purely for research purposes according to animal welfare regulations.

- Group 1: Beet root juices 20-30ml twice daily+(3 dose at 3mg/kg) iron sucrose with 100ml 0.9% w/v NaCl sol^{n} for 2-5 min I/V injection at 7 days interval
- Group 2: Beet root juices 20-30ml twice daily+(2 dose at 3mg/kg) iron sucrose with 100ml 0.9% w/v NaCl sol^{n} for 2-5 min I/V injection at 7 days interval
- Group 3: Beet root juices 20-30ml twice daily+(single dose at 3mg/kg) iron sucrose with 100ml 0.9% w/v NaCl sol^{n} for 2-5 min I/V injection at 7 days interval
- Group 4: Beet root juices 20-30ml twice daily+ Single Iron capsule (Carbonyl iron-50 mg, Folic acid 0.50mg, zinc sulfate-61.80mg)
- Group 5: Beet root juices 20-30ml twice daily for 35 days.

Collection of blood samples

Following a thirty-five days clinical trial, every 7 days interval blood sample was collected from the jugular vein with a 5ml syringe fitted with 21G needles and placed into vials coated with ethylenediaminetetraacetic acid (EDTA), then gently mixed to ensure an even distribution of EDTA. These blood samples were obtained in a blinded manner to reduce measurement bias to treatment groups.

Measurement of blood parameters

Auto Hematology Analyzer (BC-6000), Manufactured by (Shenzhen Mindray Bio-Medical Electronics Co., Ltd. China) was used to assess hematological parameters. Parameters measured were: red blood cell (RBC) count, hemoglobin (Hb) concentration, white blood cell (WBC), platelet count test (PLT), hematocrit test (HCT). Calibration was done to maintain the accuracy of the BC-6000 hematology analyzer.

Statistical analysis

Results are presented as mean ± standard error of mean (SEM). Statistical Package Statistics 10 was used and analyzed by one-way ANOVA (Tukey's Test); $p \leq 0.05$ was considered statistically significant in all analyses.

RESULTS

Tables 1 and 2 display the results of a Tukey HSD all-pairwise comparison evaluating the effects of red beetroot juice on various hematological parameters, specifically red blood cell (RBC) count, hemoglobin (Hb), white blood cell (WBC) count, and hematocrit (HCT) levels across five groups at three different time points: Day 1 (D1), Day 14 (D14), and Day 35 (D35).

Table 1: Effect of red beetroot juice on red blood cells count (RBC) and Hemoglobin (Hb) levels.

Parameters	RBC			Hb		
	D1	D14	D35	D1	D14	D35
Group1	2.59c	2.56c	2.52b	3.82b	4.33d	4.33c
Group2	2.79bc	3.93ab	6.53a	6.29a	9.07bc	12.91a
Group3	3.49a	4.23a	6.12ab	7.18a	11.51a	13.84a
Group4	3.44ab	3.65ab	5.08bc	6.10a	9.35b	12.2ab
Group5	2.86abc	3.36b	4.80c	5.89a	7.19cd	10.58b

Values with the different superscripts in the same column are statistically significant at $p<0.05$; N.B: Group1: Beetroot juices 20-30ml twice daily+(3 dose at 3mg/kg) iron sucrose, Group 2: Beetroot juices 20-30ml twice daily+(2 dose at 3mg/kg) iron sucrose, Group 3: Beetroot juices 20-30ml twice daily+(single dose at 3mg/kg) iron sucrose, Group 4: Beetroot juices 20-30ml twice daily+ Single Iron capsule, Group 5: Beet root juices 20-30ml twice daily for 35 days.

Table 2: Effect of red beetroot juice on white blood cell (WBC) and Hematocrit (HCT) levels.

Parameters	WBC			HCT		
	D1	D14	D35	D1	D14	D35
Group1	7.47ab	7.75bc	7.52b	16.82b	20.26b	20.62d
Group2	7.16ab	8.36b	11.19a	20.13ab	29.37a	35.924bc
Group3	8.43a	10.27a	10.81a	23.33a	31.08a	43.166a
Group4	8.68a	8.67b	10.33ab	23.44a	30.56a	34.044c
Group5	5.74b	6.67c	8.82b	19.82ab	28.37a	35.767bc

Values with the different superscripts in the same column are statistically significant at $p<0.05$; N.B: Group1: Beetroot juices 20-30ml twice daily+(3 dose at 3mg/kg) iron sucrose, Group 2: Beetroot juices 20-30ml twice daily+(2 dose at 3mg/kg) iron sucrose, Group 3: Beetroot juices 20-30ml twice daily+(single dose at 3mg/kg) iron sucrose, Group 4: Beetroot juices 20-30ml twice daily+ Single Iron capsule, Group 5: Beet root juices 20-30ml twice daily for 35 days.

In Table 1, there was an overall increase in RBC and Hb levels across all treated groups over time. In Group1, the RBC count at D1was "2.59c" then reached to the level of "4.97bc" at D35 while, Group2 exhibited the RBC count "6.53a" at D35 from "2.79bc" at D1, followed by Group3 "6.12ab" at D35 from "3.49a" at D1, which

indicated a beetroot treatment specific improvement. At D35, hemoglobin levels also showed significant increases, especially in Group1 "12.20ab", Group2 "12.91a" and Group3 "13.84a" from Group1 "3.82b", Group2 "6.29a" and Group3 "7.18a" at D1 reflecting a considerable enhancement in oxygen-carrying capacity that may be attributed to beetroot supplementation comparing to Group4 and Group5. These findings are consistent with the research conducted by Beshel *et al.* (2018).

Table 2 illustrates the effects on WBC and HCT levels. The WBC count showed a steady increase in most groups, at D1the level was Group1 "7.47a", Group2 "7.16ab" and Group3 "8.43a" at D35 increased the level in Group1 "11.18a", Group2 "11.19a" and Group3 "10.81a" respectively. Likewise, at D35 hematocrit level was lower due to the RBC count in both Group4 "34.044c" and Group5 "35.767bc" while it was the highest in Group1 "40.62ab" at D35 from D1value comparing to Group2 "35.924bc" and Group3 "43.166a". This finding aligns with the study by Jaiswal *et al.*, 2014. Additionally, hematocrit levels demonstrated a consistent rise across all groups after the treatment over time. Whereas Group1 reached the highest HCT value from "16.82b" at D1 to "40.62ab" at D35, indicating enhanced erythropoiesis and regulation of blood viscosity, and these results correspond with the findings of Maximas *et al.*, 2014. RBC levels significantly increased in Group2 over time, ($p \leq 0.05$) in Figure 1. Figure 2 shows enhanced Hemoglobin level in Group1 after the treatment and $p \leq 0.05$ was considered statistically significant. In Figure 3, Hematocrit value was highest in Group1 at day 35 and p-value of ≤ 0.05 was deemed statistically significant. WBC level in Figure 4 increased in all groups specially Group2 over time ($p \leq 0.05$). In Figure 5, Platelet level was significantly enhanced in Group1 and Group2 ($p \leq 0.05$).

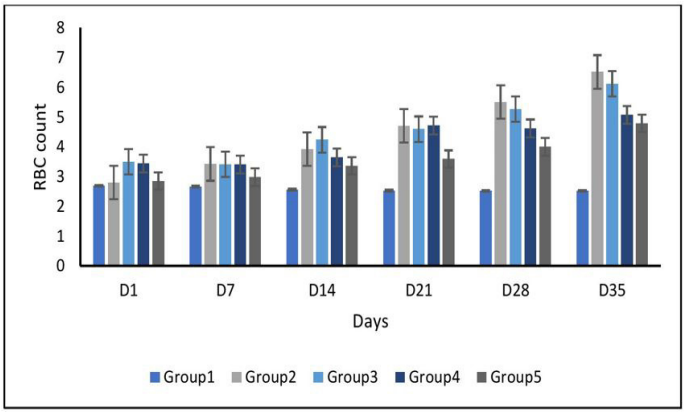

Figure 1: Effect of *Beta vulgaris* juice on red blood cell count (RBC) in anemic dogs. Data are presented as mean ± standard error mean and analyzed by one-way ANOVA (Tukey's Test); $p \leq 0.05$ was considered statistically significant in all analyses.

Figure 6, illustrates a correlation between Hb and HCT reveals a strong and highly significant positive relationship of 0.837***, indicating that as hemoglobin levels increase, the hematocrit value also rises. Similarly, Hb and RBC exhibit a strong positive and significant correlation of 0.738**, which implies that a higher level of hemoglobin corresponds with an elevated red blood cell count. Furthermore, red blood cell concentration affects the hematocrit value, as evidenced by the strong and significant correlation of 0.783*** between RBC and HCT. In contrast, the correlation between RBC and WBC indicates a moderate yet significant relationship of 0.595*.

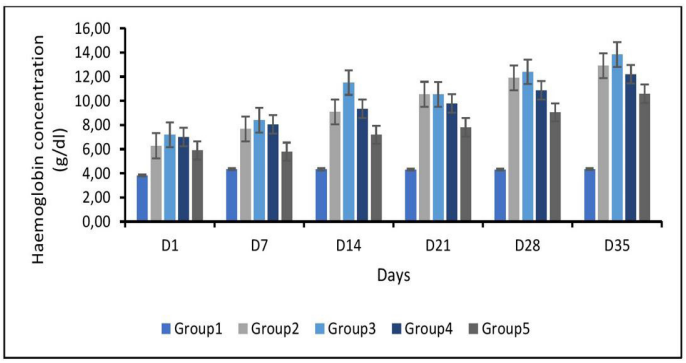

Figure 2: Effect of *Beta vulgaris* juice on hemoglobin (Hb) concentrations in anemic dogs. The results are expressed as mean ± standard error mean and assessed using one-way ANOVA (Tukey's Test); a p-value of ≤ 0.05 was regarded as statistically significant in all evaluations.

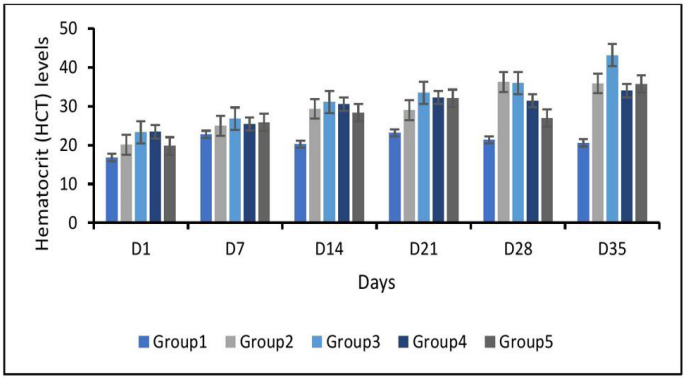

Figure 3: Impact of *Beta vulgaris* juice on hematocrit (HCT) levels in dogs with anemia. The data is expressed as mean ± standard error mean and evaluated using one-way ANOVA (Tukey's Test); a p-value of ≤ 0.05 was deemed statistically significant in all evaluations.

Figure 7, presents a correlation matrix and scatterplot analysis following 14 days of treatment. A strong positive correlation of 0.731** exists between RBC and Hb, while WBC and HCT show a robust positive correlation of 0.703**. Furthermore, there is a very strong positive correlation of 0.816*** between Hb and WBC, as well as a strong positive correlation of 0.768*** between RBC and WBC, and a moderate correlation of 0.543* between PLT and WBC has been observed.

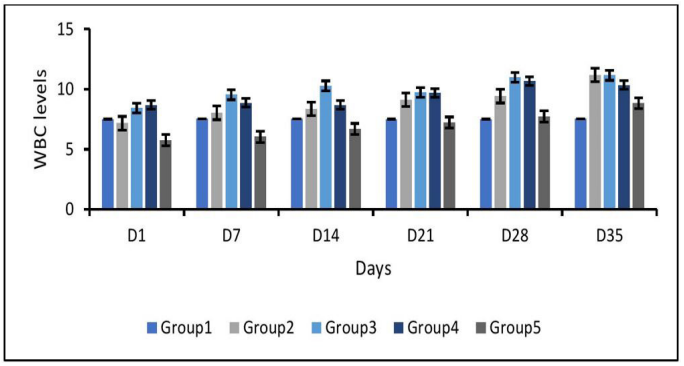

Figure 4: Effect of *Beta vulgaris* juice on white blood cell (WBC) levels in anemic dogs. Data are presented as mean ± standard error mean and analyzed by one-way ANOVA (Tukey's Test); p<0.05 was considered statistically significant in all analyses.

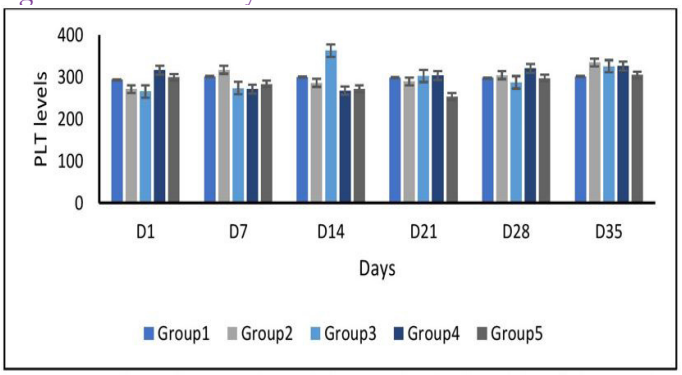

Figure 5: Effect of *Beta vulgaris* juice on platelet (PLT) levels in anemic dogs. Data are presented as mean ± standard error mean and analyzed by one-way ANOVA (Tukey's Test); p ≤ 0.05 was considered statistically significant in all analyses.

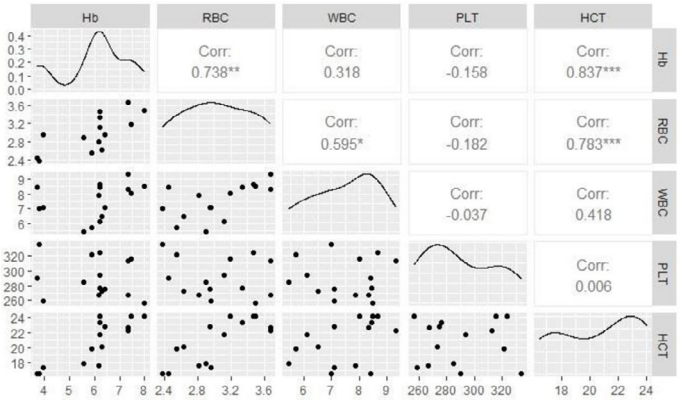

Figure 6: Enhanced plot correlation of beetroot juice on hematological parameters at day 1.

Figure 8, graph is a correlation matrix with scatterplots and density curves after 35 days of treatment. The diagonal plots depict the distribution of each variable, showing that Hb and RBC exhibit a mildly skewed distribution, whereas PLT and HCT are more normally distributed. The lower triangular section contains scatterplots that display the variation and trends between each trait pair. A strong positive correlation (r= 0.779, p<0.001) that is statistically significant is observed between Hb and WBC.

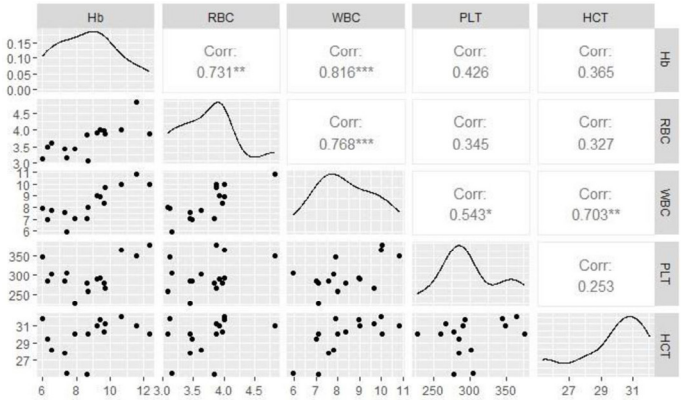

Figure 7: Enhanced plot correlation of beetroot juice on hematological parameters at day 14.

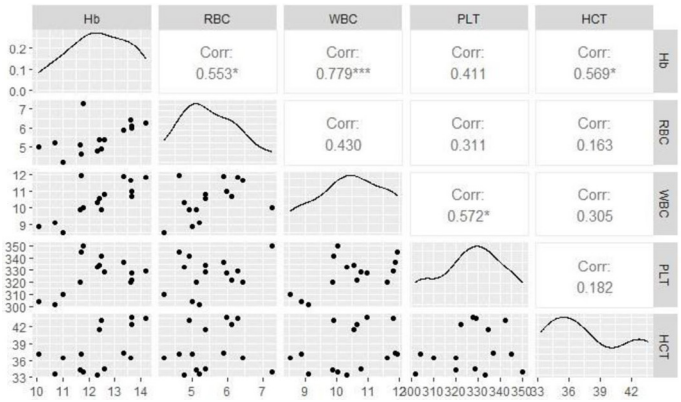

Figure 8: Enhanced plot correlation of beetroot juice on hematological parameters at day 35.

DISCUSSIONS

The data presented in Figure 1 showed that the levels of red blood cells (RBC) were reduced in Group1 at D1. After the treatment in Group1, which received three doses of 3mg/kg body weight iron sucrose and beetroot juice twice daily met the highest RBC count at D35 compared to other groups. Group2 and Group3 were the anemia treatment group which received two doses and one dose of 3mg/kg body weight iron sucrose and beetroot juice respectively and both groups exhibited significantly higher RBC counts at D35 when compared to the anemia treatment Group4. In Group4 the treatment was carried out with iron capsule and beetroot juice represented a slower enhancement of RBC level than G1. Group5 was treated with only beetroot juice (20-30 ml) twice daily for 35 days and the result was reduced than the other treatment groups especially G1, G2 and G3. According to Macmillan *et al.* (2005), beetroot has a positive effect on anemia by reducing the destruction of red blood cells. In this study baseline anemia severity was significantly higher in Group1, Group2, Group3,

respectively compared to Group4 and Group5 and the difference was considered during interpreting treatment response. The results showed that the pairing of beetroot juice with iron sucrose significantly raised RBC counts in anemic dogs compared to groups that received solely beetroot juice or iron capsules mixed with beetroot, aligning with the findings of Jaiswal *et al.* (2014). Figure 2 illustrates a notable increase in hemoglobin levels in G1, G2 and G3 at day 21, 28 and 35 who were fed beetroots and iron sucrose together, in comparison to G4 and G5. In G1 group three doses of iron sucrose corrected the anemia significantly than others and the oral intake of beetroot juice mitigated the detrimental effects of anemia in the dogs from the combined treatment groups (G1, G2 and G3). According to the findings of Jaiswal *et al.* (2014), the administration of beetroot juice initiated proper regulation of heme biosynthesis, resulting in an elevation of hemoglobin concentration. This outcome supports the current observation that anemic groups receiving both beetroot juice and iron sucrose showed higher hemoglobin levels compared to those receiving less dose of intravenous iron sucrose, iron capsules or only beetroot juice. While G4 and G5 achieved similar results, it did not surpass the effects observed in the combined treatment groups of iron sucrose. The current findings are consistent with the findings reported by Indhumathi *et al.* (2012).

The study findings presented in Figure 3 indicate a significant increase ($p<0.05$) in hematocrit levels at day 35 in G1 compared to other groups. At D1 the level was below 20 which reached to above 30 at D35. While in G2 and G3 from 20 to close to 30 at D35. In case of G4 and G5 Hb level was 20 or below 20 to above 20 at 35. This enhancement was achieved by administering beetroot juice alongside iron sucrose. Beetroots are rich in folic acid, ascorbic acid, and iron. Folic acid helps in the absorption of iron from the gastrointestinal tract for hemoglobin production. These comments are accepted with Beshel *et al.* (2018). In this research, HCT(PCV%) showed a significant increase in anemic dogs that received combined iron sucrose and beetroot juice treatment. Furthermore, the combination of beetroot treatment demonstrated remarkable anti-anemic properties. These results are similar with the findings of Cho *et al.* (2016).

White blood cell counts were significantly elevated in all groups depicted in Figure 4, with the exception of group 5. Dogs with anemia in G1, G2 and G3 experienced a peak in their counts. The WBC count increased significantly with the consumption of beetroot juice and intravenous injection of iron sucrose compared to groups that received iron in capsule form with beetroot, or only oral beetroot administration. These findings are consistent with the results presented by Maximas *et al.* (2014). This effect may be due to the presence of phytochemicals such as phenolics, flavonoids, vitamins E and C, thiamine, as well as increased levels of enzymes like superoxide dismutase, glutathione peroxidase, and catalase found in beetroot juice, along with its protective advantages.

The findings presented in Figure 5 indicated that platelet (PLT) levels were the highest across most groups throughout the trial period from day 1 to day 35 with an exception of G5. Furthermore, G1, G2 and G3 reached their peak values on day 35. The anemic groups that were administered iron sucrose and beetroot juice at all treatment levels showed significantly elevated serum platelet levels compared to those who received either none or a single beetroot treatment. Consequently, the water-soluble vitamins and minerals present in beetroot are believed to contribute to its beneficial effects on blood health (21; vitamins Harvard). Additionally, this research highlighted a significant enhancement ($p< 0.05$) in hematological parameters with a least association in platelet values within the context of an anti-anemia clinical trial study. These observations are consistent with the findings of Nora (2018), Gheith *et al.* (2018), and Lotfi *et al.* (2018).

In Figure 6, the correlation matrix plot shown on D1 depicts the significant positive correlation between hemoglobin (Hb) and hematocrit (HCT) ($r = 0.837$, $p < 0.001$) supports established hematological principles, indicating that hemoglobin in red blood cells is crucial for oxygen transport, while beetroot contributes to erythropoiesis during the study period. Hb also exhibits a strong positive correlation with RBC ($r = 0.738$, $p < 0.01$), and RBC correlates significantly with HCT ($r = 0.783$, $p < 0.001$), suggesting a consistent rise in red cell metrics. In this research, the white blood cell (WBC) and platelet counts represent different hematopoietic lineages and their specific roles, in agreement with Beshel *et al.* (2018). The moderate correlation ($p < 0.05$) seen between WBC and PLT indicates that these variables are unlikely to be influenced by this condition.

Figure 7, illustrates a significant positive correlation between Hb and WBC ($r= 0.816$, $p<0.001$) as well as between RBC and WBC ($r= 0.768$, $p<0.001$), indicating a coordinated response in RBC and WBC levels following prolonged exposure to beetroot on D14. Additionally, there is a strong correlation between Hb and RBC ($r= 0.731$, $p<0.01$), which aligns with stimulation of erythropoiesis (Maximas *et al.*, 2014). WBC and HCT also show a robust positive correlation ($r= 0.703$, $p<0.01$) while WBC and PLT exhibit a moderate correlation ($r= 0.543$, $p<0.05$) suggesting activation of both the immune system and platelet function. Moreover, PLT is moderately correlated with Hb ($r= 0.426$) and RBC ($r= 0.345$), although these associations are not statistically significant. In general, HCT demonstrates a weaker correlation with most

parameters at this stage (r= 0.365 with Hb and r= 0.327 with RBC), although it is trending positively. This suggests that beetroot may have cumulative effects on hematopoiesis and immune modulation over time, enhancing both red and white blood cell profiles alongside moderate support for platelets.

On D35, the data illustrated in Figure 8 reveals strong positive correlations between hemoglobin (Hb) and white blood cells (WBC) (r= 0.779, P<0.001), indicating that beetroot consumption may enhance both blood cell metrics simultaneously. Furthermore, Hb and hematocrit (HCT) show a significant positive correlation (r= 0.569, p<0.05), demonstrating a relationship between hemoglobin levels and hematocrit measurements. Additionally, Hb and red blood cells (RBC) are also significantly positively correlated (r= 0.553, p<0.05), which supports the findings of Jaiswal *et al*. (2014). On the other hand, a moderate yet significant positive correlation (r= 0.572, p<0.05) indicates that beetroot may simultaneously impact immune cell and platelet production. The other variable combinations, such as RBC and platelets (PLT) (r= 0.311), PLT and HCT (r= 0.182), and WBC and HCT (r= 0.305), exhibited weak or non-significant correlations. These findings indicate that beetroot supplementation has a beneficial impact on various key blood parameters, especially hemoglobin, which may suggest improved oxygen transport and immune function in the dogs during the treatment phase, while acknowledging the limitations of the control group and the small sample size. This supports the potential hematopoietic and immunomodulatory properties of beetroot, likely due to its high nitrate and antioxidant content, aligning with the findings of Maximas *et al*. (2014).

Finally, to be concluded that feeding of beetroot juice with a combined iron sucrose treatment positively modulated hematological parameters of canine blood serum suggesting beetroot juice an anti-anemic agent compared to the iron capsule. Iron capsule with beetroot juices also respond treating anemia while it may take several months to recover which may deteriorate body condition due to weakness, loss of appetite and reduced immunity. Therefore, oral beetroot juice with three dose iron sucrose can correct it rapidly and it can minimize the oxidative stress with other gastro intestinal disturbances and other side effects of iron sucrose injection that may compromise the overall health of the animal.

CONCLUSION

The pairing of beetroot juice and iron sucrose injection presents a safe and an effective alternative to traditional treatments for anemia in dogs comparing to iron capsule. Beetroot supports the process of erythropoiesis and increases hemoglobin level. While the initial findings are promising, additional large-scale randomized controlled trials are recommended to draw a strong conclusion and to determine appropriate dosages and long-term implications. All of the animals completed the study and no medication related reactions were observed amongst the studied animal. Although the current study indicates that the combination of iron sucrose injection and beetroot is effective in treating anemia in dogs and alleviating stress, it is advisable to minimize the dosage of iron infusion as much as possible because it may deteriorate the body condition due to weakness, waned immunity and appetite. Ultimately, incorporating beetroot juice into veterinary care could offer an accessible and holistic method for addressing anemia in dogs.

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NOVELTY STATEMENT

This research represents the initial evidence that the combination of beetroot juice and iron sucrose injections provide a safe, effective, and comprehensive alternative to traditional iron capsule treatments for anemia in dogs, emphasizing the promise of a natural dietary supplement to boost erythropoiesis and lessen stress associated with treatment.

AUTHOR'S CONTRIBUTION

MH: Conceptualization, supervision, methodology, project administration.
MAZ: Data curation, formal analysis, Writing- review and editing.
MSI and AW: Writing- review and editing.

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Ethical approval

The animals involved in this research were in accordance with all applicable national regulations and institutional guidelines for the care and utilization of animals and informed consent was taken from the dog owner. The ethical approval number was SAU/ASVM-11/2024.

Abbreviations

RBC, Red Blood Cell; Hb, Hemoglobin; WBC, White Blood Cell; HCT, Hematocrit; PLT, Platelet.

Generative AI and AI-assisted technology statement

No AI tool was used during the preparation of this manuscript, all scientific content is made solely by the authors.

Conflict of interest

The authors have declared no conflict of interest.

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