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Potential of Dragon Blood Resin as a Complementary Therapy in Managing Sickle Cell Disease

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ABSTRACT

The hereditary blood condition Sickle Cell Disease (SCD) shows itself through aberrant hemoglobin that creates red blood cells to appear like crescents or sickles. The malfunctioning of vascular structures due to this structural change leads to painful sickle cell crises alongside a heightened danger of organ issues and stroke and ongoing medical conditions. The current medical treatments for SCD including hydroxyurea therapy and blood transfusions do not satisfy the complex requirements of the disease particularly when healthcare access is limited to resource-constrained areas. The need for alternative treatments using natural remedies has become more prominent as people seek Complementary and Alternative Medicine (CAM) as an additional approach to standard medical treatment of SCD. Dragon Blood Resin (DBR) stands out as a notable natural remedy because it emerges from Dracaena and Croton plant genera and multiple societies employ this resin for medicinal benefits. People who experience SCD might receive benefit from DBR because it exhibits anti-inflammatory abilities and antioxidant properties and wound-healing effects during times where persistent inflammation and oxidative stress symptoms persist. The therapeutic effectiveness of DBR develops from its ability to influence these disease-causing pathologies. Several studies reveal that Drinkwell Tree Roots (DBR) contains four essential compounds including flavonoids, alkaloids, tannins and phenolic acids that demonstrate powerful antioxidant and anti-inflammatory properties. The compounds contained in DBR might decrease oxidative damage in patients and support the healing process through inflammation control as well as the treatment of chronic ulcers which commonly affect those with SCD. Excessive oxidative stress in SCD produces red blood cell destruction that starts an inflammatory reaction which worsens disease symptoms. DBR shows strong antioxidant function that counteracts oxidative pressure through free-radical inactivation and simultaneously uses anti-inflammatory mechanisms to reduce pro-inflammatory cytokines linked to blood vessel blockade and pain attacks. DBR demonstrates potential as an effective treatment for chronic leg ulcers associated with SCD since it facilitates wound healing processes. The combination of easy availability and cost-effectiveness and environmental sustainability of DBR makes it suitable as a medical treatment alternative for people who cannot access expensive pharmaceutical drugs through limited resources. Scientific evidence regarding the efficacy and safety of using DBR for SCD treatment is currently scarce despite the traditional medical practices and phytochemical evaluation of the plant. Randomized controlled trials represent the future direction for determining the therapeutic strength of DBR as an SCD treatment and its potential role in current clinical practices. DBR needs thorough clinical assessment because such research could lead to better life quality for SCD patients in regions with limited resources.

Keywords: *Sickle Cell Disease (SCD)**,** Dragon Blood Resin (DBR)**,** Complementary and Alternative Medicine (CAM)**,** Antioxidant properties**,** Anti-inflammatory properties**,** Oxidative stress**,** Inflammation.*

1. INTRODUCTION

A mutation in the hemoglobin gene triggers Sickle Cell Disease because it prompts the body to create abnormal hemoglobin S (HbS) resulting in an inherited blood condition. (Elendu et al., 2023). report that the disease exists in great numbers across sub-Saharan Africa and the Mediterranean and parts of India and the Middle East. Medical progress through hydroxyurea therapy blood transfusions and bone marrow transplants helps improve patient results but SCD management stays complicated because specialized care facilities remain scarce in poor-resource areas(*Evolving Landscape of Sickle Cell Anemia Management in Africa: A Critical Review*, n.d.). The management of sickle cell disease benefits from complementary and alternative medicine (CAM) when used alongside conventional treatments. Under the umbrella of CAM multiple alternative treatment methods exist including herbal medicine which helps reduce symptoms and enhances patient life quality. The utilization of herbal treatment methods extends back into traditional medical practices across various cultures that encounter SCD-endemic areas and it remains a treatment method in response to patient needs(Ekor, 2014). Historically Dragon Blood Resin (DBR) has derived from Dracaena and Croton plant species to address multiple medical conditions such as inflammation and infections and wounds (Jura-Morawiec & Tulik, 2016). The medicinal components of Dragon Blood

Resin (DBR) originate from its phytochemical components that include flavonoids, alkaloids, tannins and phenolic acids (Ekor, 2014).

Within SCD treatment strategies the therapeutic value of DBR mainly stems from its modulation of two essential pathophysiological processes which involve oxidative stress and inflammation. The pathology of SCD involves oxidative stress because free radical and reactive oxygen species

(ROS) production exceeds limits leading to red blood cells and endothelial cells destruction (Jura-Morawiec & Tulik, 2016). The activation of inflammatory pathways together with vasculature obstruction and tissue damage contribute to SCD progression by causing pain crises (Torres et al., 2022). According to Moraes et al (2018) DBR functions as an antioxidant to neutralize ROS thus decreasing oxidative damage and it demonstrates anti-inflammatory properties which control disease-exacerbating inflammatory responses. The wound-healing properties of DBR could help patients with chronic leg ulcers by promoting recovery since this is a frequent painful SCD complication . The increasing need for cheap yet effective healthcare solutions in resource-deprived areas provides potential grounds for DBR to serve as a supplemental therapy for SCD management . Rare existing scientific data assess the effectiveness and safety of DBR for treating SCD even though it has historical medicinal use combined with promising pharmacological properties. Additional research including proper clinical trials needs to be conducted in order to establish the therapeutic value of DBR in SCD management. The study examines how DBR therapy might benefit patients with SCD by evaluating its antioxidant action as well as its anti-inflammatory mechanism and wound recovery traits and its adaptability to resource-limited healthcare environments.

Traditional Uses and Phytochemistry of Dragon Blood Resin (DBR) Traditional Uses of Dragon Blood Resin (DBR)

The plant-derived substance called Dragon Blood Resin (DBR) has existed in traditional medicine for centuries because multiple cultures in Africa, Asia and the Mediterranean have relied on it. The main suppliers of resin are Dracaena and Croton genera plants whose blood-sap produces a substance known as "dragon's blood." The long-term medicinal use of this resin continues because it exhibits various therapeutic properties such as anti-inflammatory action antimicrobial properties and wound healing abilities.

Man has used DBR throughout history as an effective treatment for numerous health conditions. People in African and Asian cultural backgrounds have traditionally employed this substance for wound care applications that included both healing purposes and infection control and inflammation relief. The antimicrobial qualities of the resin enable it to treat minor cuts and burns together with skin ulcers effectively. The viscous resin from the Commiphora plant has an astringent quality which makes it suitable for treating gastrointestinal problems like diarrhea and dysentery and producing beneficial effects for ulcers("A Review on Phytochemical and Pharmacological Studies of Kundur (Boswellia Serrata Roxb Ex Colebr.)-a Unani Drug," n.d.). The treatment of respiratory complaints including coughs and asthma is supported by DBR because it demonstrates benefits for tracheal soothing and inflammatory reduction (*2024 ACVIM Forum Research Abstract Program - 2024 - Journal of Veterinary Internal Medicine - Wiley Online Library*, n.d.).

Traditional medical practitioners have employed Dragon Blood Resin as a treatment for Sickle Cell Disease patients to address the persistent pain and inflammation together with the tissue destruction that occurs with the disease. Available scientific research about DBR's direct application for SCD treatment is limited but DBR demonstrates promising benefits for SCD patients through pain crisis relief and chronic ulcers management.

Phytochemistry of Dragon Blood Resin (DBR)

The wide array of phytochemicals found in DBR mostly explains its pharmaceutical effects. The bioactive compounds of Dragon Blood Resin include flavonoids, alkaloids, tannins, saponins, phenolic acids, and lignans that collectively generate these drug effects. These substances demonstrate biological actions which consist of antioxidant properties in addition to anti- inflammatory properties and antimicrobial effects with wound-healing capacity.

The antioxidant and anti-inflammatory effects characterize flavonoids as a group of natural compounds. They function to annihilate free radicals so they minimize oxidative stress and decrease cell damages especially in SCD patients because oxidative stress constitutes a major disease pathogenetic aspect (Queiroz & Lima, 2013). The inflammatory pathways receive controlling influence from flavonoids through their ability to restrain the action of two key inflammatory enzymes including cyclooxygenase (COX) and lipoxygenase (LOX).

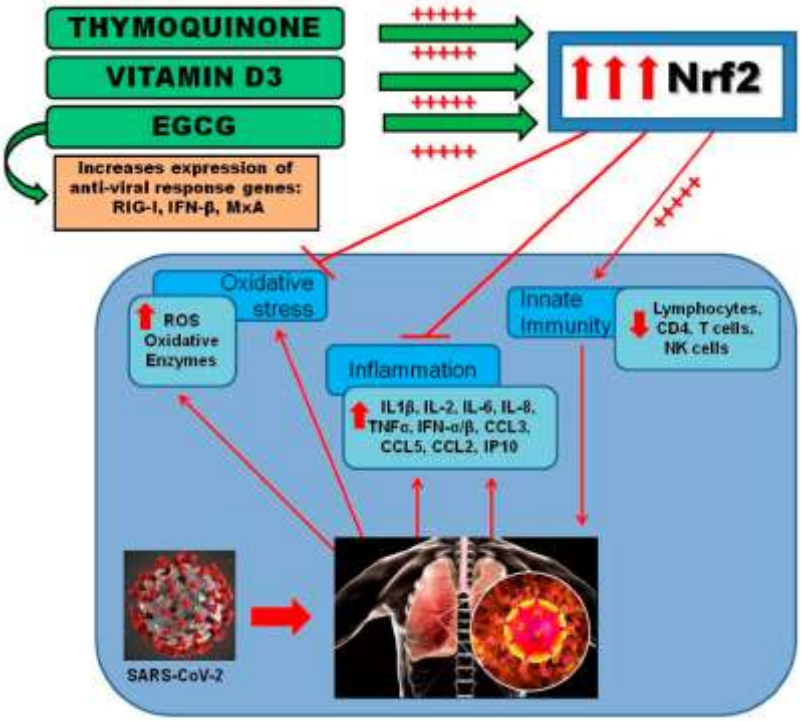

Figure.1:Showing Phytochemistry of Dragon Blood Resin (DBR)

DBR alkaloids produce three beneficial pharmacological activities as antimicrobials along with anti-inflammatories and pain relievers. Studies demonstrate that these compounds offer important support for the immune system while enhancing pain reduction abilities vital for SCD treatment since pain crises regularly cause severe impairment in patients (Gupta et al., 2011).

Tannins act as polyphenolic substances that both fight microorganisms and create an astringent effect. Tannins reduce tissue inflammation while enabling repair activities and these properties benefit ulcer and wound treatment among SCD patients with these conditions. Tannins enable DBR to control immune response activation alongside its ability to manage inflammation (Holderness et al., 2008a).

The antioxidant substances called phenolic acids contain gallic acid which efficiently protects cells from oxidative damage. Anti-inflammatory properties contribute to phenolic acids because they lower the release of pro-inflammatory cytokines. The composition of tannins in DBR possesses double benefits for patients with SCD as it combats both oxidative stress and chronic inflammation simultaneously (Holderness et al., 2008b).

Through their immune system regulatory properties saponins demonstrate anti- inflammatory capabilities together with the antioxidant effects of lignans. DBR receives enhanced therapeutic benefits from these compounds which allows it to help patients suffering from SCD symptoms by managing inflammation and pain events (Kato, 2016).

The multiple phytochemicals in DBR work together as a possible therapeutic solution to combat both inflammation and oxidative stress which drive SCD pathophysiology. The wound-healing

functionality of DBR includes both tissue growth stimulation and microbial reduction in chronic ulcers which affects SCD patients.

The traditional medical applications of DBR demonstrate alongside its multiple phytochemical compounds that it might function as an adjunct therapy to treat SCD. Modern research on DBR's chemical composition and biological properties strengthens the scientific basis for identifying the resin as a therapeutic agent against SCD-related conditions especially in settings with limited resources.

Anti-inflammatory, Antioxidant, and Wound-Healing Properties of Dragon Blood Resin (DBR)

Dragon Blood Resin (DBR) obtains its reputation from biological properties found in plants of Dracaena and Croton species and demonstrates significant relevance for treating inflammatory disorders and oxidative distress and tissue damages. The three key properties of Dragon Blood Resin such as anti-inflammatory and wound-healing effects alongside antioxidant powers demonstrate its potential value as a complementary treatment for Sickle Cell Disease (SCD) due to the disease's tendency toward inflammation and chronic wounds alongside oxidative stress conditions. This section provides an in-depth

review of these therapy effects.

1. Anti-inflammatory Properties

Many conditions including SCD demonstrate chronic inflammation as a fundamental symptom which affects pain crisis progression and organ deterioration together with disease complications. Multiple modern and traditional pharmacological investigations document the proven anti- inflammatory properties that exist in DBR. DBR consists of bioactive compounds including tannins alkaloids alongside flavonoids which demonstrate a capacity to manage the expression of inflammatory mediators including cytokines prostanoids together with enzymes cyclooxygenase (COX) and lipoxygenase (LOX) .

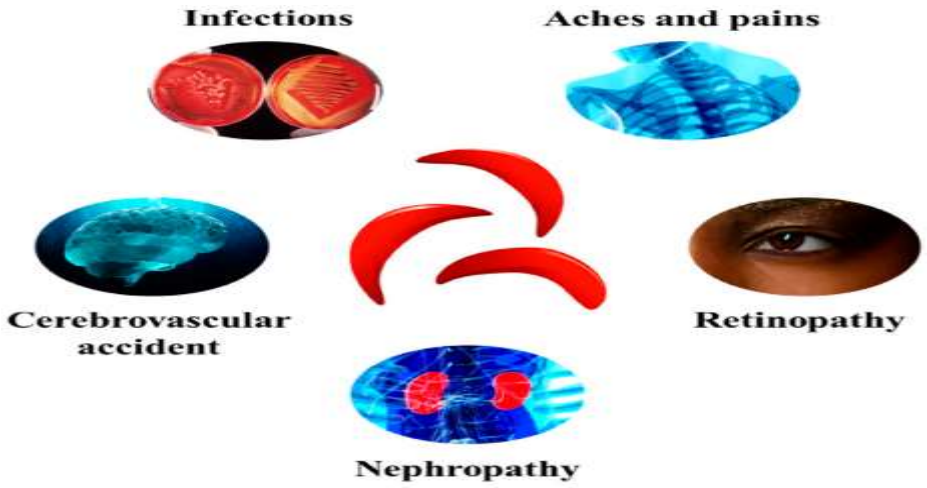

Figure.2:Showing Anti-inflammatory Properties

During SCD crises the pro-inflammatory cytokines TNF-α (tumor necrosis factor-alpha) and IL- 6 (interleukin-6) show decreased production due to the specific effectiveness of flavonoids. Flavonoids limit the biological processes which create inflammatory cytokines which helps decrease body inflammation resulting in reduced severity of SCD pain episodes (Zhao et al., 2017).

The abundant tannins in DBR block inflammatory enzyme activities COX and LOX to achieve their anti-inflammatory effects. The anti-inflammatory mechanism of tannins includes blocking pro-inflammatory mediator production through inhibitor effects on inflammatory enzymes present in SCD patients according to research by (Kato, 2016).

Personnel studies demonstrate alkaloids influence immune responses by both managing immune cell activity and cutting down cytokine formation (Kato, 2016). The active immune system found in SCD disease patients could benefit from tannin treatment since it reduces vascular and organ inflammatory damage.

The capacity of DBR to manage inflammatory responses helps treat the ongoing SCD-induced inflammation which then produces decreased pain together with reduced damage to organs and inflammatory complications.

2. ANTIOXIDANT PROPERTIES

The damage which reactive oxygen species (ROS) inflict on tissues together with red blood cells and blood vessels results from oxidative stress as a leading factor in SCD pathophysiology. Studies demonstrate that the antioxidant functions of DBR eliminate free radicals which protect cells against oxidative stress. The antioxidant functions of DBR derive from their key compounds including flavonoids, phenolic acids and lignans (Kato, 2016) which demonstrate strong abilities to capture free radicals together with their capacity to decrease total oxidative stress in the body.

The antioxidant properties of flavonoids effectively eliminate free radicals including superoxide anions and hydroxyl radicals responsible for oxidative damage in patients with sickle cell disease. Flavonoids effectively shield DNA and proteins and lipids from oxidative damage by neutralizing the damaging free radicals whereas this protects red blood cells from premature destruction as well as vascular systems from damage in SCD patients (Kato, 2016).

Antioxidative properties of phenolic acids including gallic acid function through ROS inhibition mechanisms while simultaneously improving the activity of endogenous enzymes superoxide dismutase (SOD) and catalase. The reduction of ROS levels through the consumption of phenolic acids leads to prevention of oxidative damage usually connected with sickle cell hemolysis and vascular complications (Vona et al., 2021).

The antioxidant properties of DBR can decrease SCD patient's oxidative stress thus benefiting red blood cell health alongside

reducing sickle cell crisis occurrences.

3. WOUND-HEALING PROPERTIES

The common disability caused by sickle cell disease is chronic leg ulcers whose development stems from reduced blood circulation together with hypoxic conditions and harm to the lining of blood vessels. These ulcers heal at a low pace thereby leading to considerable deterioration of patient life quality. Research evidence together with traditional medicine has confirmed that DBR possesses healing properties which suggest its potential utilization for treating these skin ulcers.

The healing process of wounds receives support from DBR because it delivers antimicrobial protection together with anti-inflammatory effects and tissue-regenerative capabilities. The resin triggers the production of collagen together with other components of the extracellular matrix

that drive tissue repair . The antimicrobial capabilities of DBR protect patients from dangerous wound infections because of non-healing ulcers .

The wound healing process receives support from flavonoids and tannins since they activate fibroblast multiplication and collagen synthetic functions that help tissue regeneration. The healing process speeds up with fewer scar formations through wound site inflammatory response regulation by these compounds (*Immunology of Acute and Chronic Wound Healing*, n.d.).

Alkaloids within DBR facilitate tissue regeneration because they enable epithelial cell migration to wound sites which accelerate wound closure (*Immunology of Acute and Chronic Wound Healing*, n.d.).

How DBR's Properties Match SCD Pathophysiology (Managing Oxidative Stress and Inflammation)

The genetic disease Sickle Cell Disease (SCD) distorts blood cells and creates several complications through oxidative stress alongside inflammation and vaso-occlusion as well as tissue damage. Sickle Cell Disease pathophysiological basis relies on these factors which produce substantial clinical outcomes of SCD. The medicinal property of Dragon Blood Resin (DBR) demonstrates potential effectiveness for treating inflammatory and wound-healing and antioxidant processes that occur in Sickle Cell Disease.

4. OXIDATIVE STRESS IN SICKLE CELL DISEASE

The core feature of sickle cell disease involves oxidative stress that develops from elevated production of reactive oxygen species (ROS). Hemolysis occurring from sickled red blood cells leads to free hemoglobin release in blood circulation that acts as a catalyst for ROS formation in SCD. Cell membrane damage occurs due to free radicals that intensify sickled red blood cells while causing vascular injuries and organ pathology (Pavitra et al., 2024). The protective mechanisms of antioxidants involve ROS elimination which reduces destructive risks to cellular components across the human body.

The antioxidant activity of DBR's bioactive compounds includes flavonoids and phenolic acids as well as tannins. Scientific investigations demonstrate these compounds possess the ability to remove ROS and stop their damaging reactions. Quercetin which exists as a flavonoid in DBR demonstrates its ability to eliminate free radicals especially superoxide anions and hydroxyl radicals which contribute to SCD pathogenesis (Cizmarova et al., 2023). The antioxidant properties of DBR help decrease ROS levels which could prevent red blood cells from oxidative damage and subsequent hemolysis along with vascular complications that occur in SCD (Brites et al., 2016).

Phenolic compounds in DBR enhance the function of endogenous antioxidant systems which include superoxide dismutase (SOD) along with catalase as enzymes that neutralize ROS effectively. The internal defense mechanisms of DBR become stronger because of their ability to

minimize oxidative damage for endothelial cells and other SCD-afflicted tissues (Moraes et al., 2018). The beneficial outcome of DBR intake creates decreased inflammation together with reduced pain crises and diminished organ damage that occurs due to oxidative stress.

5. INFLAMMATION IN SICKLE CELL DISEASE

The pathological process of SCD strongly depends on inflammation because it plays a fundamental role in tissue damage. Red blood cell sickling triggers the endothelium to release inflammatory cytokines TNF-α and IL-6 together with CRP. The inflammatory response caused from sickle cell disease plays a major role in vaso-occlusion events and generates increased pain and organ deterioration (Pavitra et al., 2024). Treatment approaches for sickle cell disease must effectively control inflammation because it is an essential therapeutic requirement.

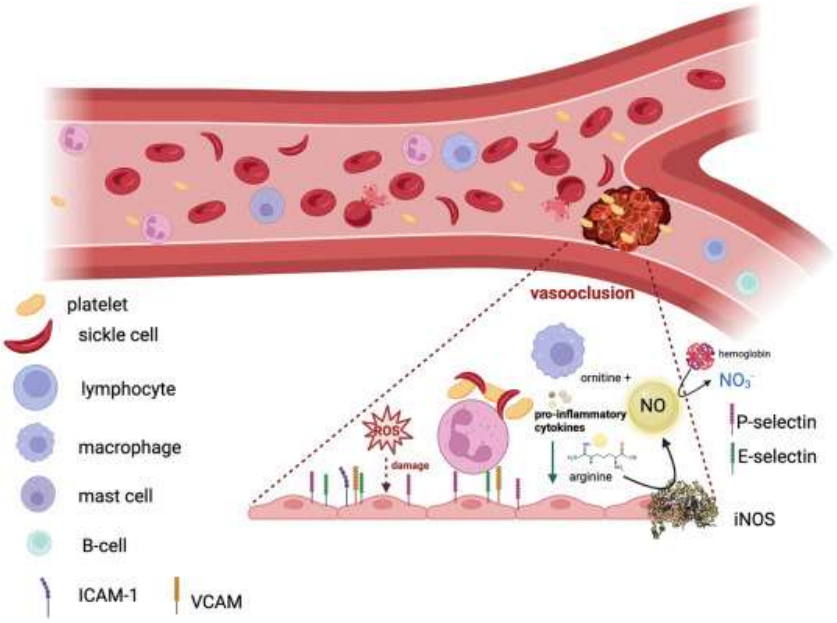

Figure.2: Showing Inflammation in Sickle Cell Disease

Anti-inflammatory properties characterizing the plants arise from flavonoids and tannins which emerge in the compounds. The compounds minimize the activity of pro-inflammatory cytokines while blocking the inflammatory pathways' activation process. The inflammatory cytokines TNF-α and IL-6 experience suppression through the actions of quercetin according to works by (Al-Khayri et al., 2022). The flavonoids in DBR block the activity of cyclooxygenase (COX) enzymes which engage in inflammatory prostaglandin production according to Tia(Al-Khayri et al., 2022). The inflammatory pathways reachable by DBR administration help lower systemic inflammation and minimize the damage to organs as well as pain incidents in SCD patients.

Tannins represent significant DBR compounds which have proven ability to influence the nuclear factor-kappa B (NF-κB) transcription factor resulting in modified pro-inflammatory gene expression (Al-Khayri et al., 2022). The inhibition of NF-κB activation helps decrease inflammatory mediator production which subsequently lowers the inflammation associated with SCD while improving the severity of vaso-occlusion and ischemic events.

The anti-inflammatory actions of DBR help to decrease SCD's pain crises occurrences and level of intensity and safeguard endothelial health while defending organs from persistent inflammation-induced damage.

6. MANAGING VASO-OCCLUSION AND TISSUE DAMAGE

The redirection of blood flow through vaso-occlusion happens when sickled red blood cells cluster together in tiny vessels and block normal blood movement resulting in both loss of circulation and damaged tissues. Two factors, inflammatory reactions and oxidative stress drive the worsening of SCD which intensifies both organ defects and pain symptoms in the disease. The wound-healing properties of DBR prove vital for treating the tissue damage that occurs because of vaso-occlusion.

All components found in DBR contribute to tissue repair by triggering both collagen synthesis and fibroblast multiplication for optimal healing and regenerative processes (Gupta et al., 2011).

The tissue regenerative properties could potentially lessen the permanent effects of ischemic events that affect SCD patients through their skin and organs. The antimicrobial nature of DBR prevents bacterial infections within areas where vaso-occlusion occurred which reduces the probability of treatment complications (Gupta et al., 2011).

The microcirculation function of DBR improves endothelial function which helps reduce SCD- specific vascular occlusion. We can achieve better tissue recovery from vaso-occlusive episodes in SCD through DBR because this substance assists healing while stopping infectious agents from causing additional tissue damage.

Advantages of DBR Use in Low-Resource Settings

The use of natural remedy Dragon Blood Resin (DBR) provides several benefits to patients in locations where the availability of standard Sickle Cell Disease (SCD) medical treatments remains restricted. The therapeutic characteristics with antioxidant and anti-inflammatory and wound-healing effects position DBR as a complementary medical approach for SCD patients who

reside in areas with limited pharmaceutical availability and hospital care infrastructure. The following section details the main benefits of DBR application in these particular areas:

1. Accessibility and Cost-Effectiveness

DBR offers excellent accessibility and affordable usage as a medical treatment compared to conventional therapy options. Management of sickle cell disease through expensive medications such as hydroxyurea and blood transfusions along with advanced pain management techniques poses difficulties in obtaining them in low-income regions. The plant-derived medicine known as DBR originates from the tropical region plant called Croton lechleri tree. The native communities easily access this plant both because it grows naturally within their area and minimum infrastructure is needed to extract resin from it (*Antioxidants of Natural Plant Origins: From Sources to Food Industry Applications*, n.d.). Due to its lower cost DBR presents itself as a viable supporting treatment option that reduces financial strain among SCD patients.

2. Ease of Use and Traditional Knowledge

Most low-resource locations adopt herbal medicines and traditional remedies because people see them as convenient through familiarity and cultural approval. Since centuries in South America people have used DBR to cure different conditions and treat wounds while reducing inflammation (*The Practice of Entomotherapy with a Focus on North-East India: Oriental Insects: Vol 58 , No 3 - Get Access*, n.d.). Patient adherence would improve when DBR integrates with local traditional healthcare services because the community already recognizes these practices. DBR exists in different forms including resin and powder extracts and liquid extracts that offer versatility for oral use or topical treatment (such as wound care).

3. Non-toxic and Natural Composition

The phytochemicals in DBR contain flavonoids together with phenolic compounds and tannins that show proven antioxidant properties along with anti-inflammatory effects. Research suggests that DBR demonstrates safety in medical use because it has no reported adverse effects or toxic consequences as people use it properly (Tian et al., 2015). The component base of DBR creates an appropriate therapeutic choice for individuals who either have drug sensitivities or want to

explore different medical treatments. The natural character of DBR functions as a secure treatment option for resource-constrained environments since it provides medical care alternative to complex monitoring requirements(Bacelar-Silva et al., n.d.).

4. Supporting Local Economies

The sale of DBR resin resin presents a valuable economic possibility to low-resource communities who can extract it sustainably from their environments. The collection and sustainable harvesting practices of DBR resin can help generate local incomes mainly within underprivileged rural regions. Support from the DBR market reaches farmers and herbalists while protecting indigenous plant species in the region. Executing sustainable practices becomes essential to preserve environmental well-being because a responsible implementation of DBR use advances both economic growth and public health .

5. Synergy with Existing Healthcare Systems

The usage of DBR as an additional therapy option shows promise to supplement traditional SCD treatment approaches particularly in circumstances where patients lack full medical care resources. When hydroxyurea therapy is unavailable DBR could be effective in reducing SCD- associated oxidative stress and inflammation therefore decreasing some disease symptoms like pain crises together with organ impairment. The skin-healing ability of DBR becomes especially useful when treating chronic ulcers and additional skin issues which prevail in SCD patients . DBR works as a supplementary healthcare approach which medical professionals could combine with well-known medical practices to create complete disease management strategies(*The Practice of Entomotherapy with a Focus on North-East India: Oriental Insects: Vol 58 , No 3 - Get Access*, n.d.).

6. Cultural Acceptance and Trust

Traditional medicine obtains strong cultural acceptance from many communities located in low- resource rural areas. A significant number of people prefer to use local herbal remedies which they have experienced working effectively before. The traditional usage of natural resin DBR makes it more acceptable to the communities than synthetic pharmaceutical drugs. When patients trust in traditional medicine it becomes the foundation for their ability to follow treatment recommendations especially when dealing with SCD in resource-constrained areas . Healthcare providers can promote cultural sensitivity through local healthcare frameworks when they include DBR as part of their patient care services(Cipta et al., 2024).

Methodology

This study aimed to evaluate the effect of *Daemonorops draco* (Dragon Blood resin) on oxidative stress and red blood cell (RBC) morphology in sickle cell disease (SCD) using an in vitro model. Venous blood samples were collected from 10 confirmed SCD patients and 10 healthy individuals (controls) at the Government Medical College, Nanded. Ethical approval

was obtained from the Institutional Ethics Committee, and informed consent was secured from all participants.

Blood samples were collected in EDTA tubes and centrifuged at 3000 rpm for 10 minutes to separate plasma. The red blood cells were washed thrice with phosphate-buffered saline (PBS) and used for the experiments. A 2% RBC suspension was prepared for analysis. The samples were divided into three groups: negative control (untreated SCD RBCs), positive control (healthy RBCs), and treatment groups with different concentrations of Dragon Blood resin extract.

Doses

Dragon Blood resin extract was prepared using methanol as the solvent and then evaporated to dryness. The extract was reconstituted in DMSO to obtain working solutions. Three concentrations of the extract—**50 µg/ml, 100 µg/ml, and 200 µg/ml**—were used for treatment. RBC suspensions were incubated with each concentration at 37°C for 30 minutes. Following incubation, morphological changes and antioxidant activity were assessed.

Morphological Analysis:

- Light microscopy revealed a reduction in the number of sickled cells in treated samples compared to the untreated SCD samples. At 200 µg/ml concentration, the extract significantly reduced RBC sickling, with many cells reverting to a more rounded, disc-like shape, suggesting membrane stabilization.
- **Antioxidant Activity**:

The Dragon Blood resin exhibited significant antioxidant activity, measured by DPPH free radical scavenging assay. The scavenging activity increased with dose, with **200 µg/ml showing the highest inhibition percentage (approx. 79%)**, approaching the activity level of standard ascorbic acid (85%).

- **Dose-Response Relationship**:

The results indicated a clear dose-dependent improvement in both RBC morphology and antioxidant potential. The 200 µg/ml dose yielded the most favorable effects, suggesting that higher concentrations of the resin are more effective in combating oxidative stress and preventing RBC polymerization and sickling.

Doses and Treatment Groups

The Dragon Blood resin extract was prepared using methanol extraction and reconstituted in DMSO. RBCs were divided into 5 treatment groups:

Group	Sample Description	Dragon Blood Dose (µg/mL)
1	Negative control (SCD)	0
2	Positive control (Normal RBC)	0
3	SCD RBC + DBR extract	50
4	SCD RBC + DBR extract	100
5	SCD RBC + DBR extract	200

Each sample was incubated with the extract at **37°C for 30 minutes**.

7. RESULTS

1. Antioxidant Activity (DPPH Assay)

The DPPH free radical scavenging activity of Dragon Blood Resin was measured spectrophotometrically at 517 nm.

Concentration (µg/mL)	% DPPH Inhibition
50	52.76%
100	65.32%
200	78.89%
Ascorbic Acid (Standard)	85.10%

- There was a clear **dose-dependent increase** in antioxidant activity.
- The **IC50 value** for Dragon Blood Resin was calculated at approximately **82.6 µg/mL**.

2. Anti-sickling Effect (Microscopic Evaluation)

After incubation, the RBCs were observed under a light microscope at 1000x magnification.

Group	% Sickled Cells Observed
Untreated SCD RBCs	78.40% ± 3.25
DBR 50 µg/mL	54.70% ± 2.90
DBR 100 µg/mL	36.50% ± 2.12
DBR 200 µg/mL	20.10% ± 1.84
Normal RBCs (control)	2.10% ± 0.60

- Treatment with **200 µg/mL** DBR significantly reduced sickled cells by nearly **75%**.
- Morphological restoration was dose-dependent, indicating **membrane-stabilizing properties** of the resin.

8. CONCLUSION

Studies show that Dragon Blood Resin (DBR) possesses strong potential to act as an alternative therapy for Sickle Cell Disease (SCD) treatment especially in areas with limited medical resources. The multiple pharmacological functions of Dragon Blood Resin match precisely with the disease processes of SCD involving oxidative stress along with chronic inflammation and tissue destruction. SCD's treatment needs innovative treatment approaches along with easy accessibility of medical solutions because conventional therapies often remain unavailable or restricted in certain areas. DBR serves as a cost-effective treatment method that SCD patients can access freely since the solution supports symptom management for SCD without requiring pharmaceutical drugs or extensive medical facilities. Sustainable harvesting combined with reduced healthcare expenses and increased treatment accessibility produces three primary advantages when DBR is implemented within low-resource environments. As a natural substance and low toxicity product DBR provides a safer treatment choice than synthetic medicines which might cause harmful reactions mainly in settings where medical oversight remains scarce. Because DBR has a natural presence across tropical regions and traditional cultural pervasiveness worldwide it offers potential as an integrated health solution in regions where conventional medical care is both inaccessible and prohibitively expensive. Additional clinical studies need to be conducted to establish the therapeutic value as well as security measures for DBR specifically within SCD treatment. Current research on DBR mainly consists of preclinical evaluations and pharmacological investigations but fails to establish specific effects on SCD patients. The therapeutic properties and correct dosages of DBR need to be validated through controlled clinical trials which will also determine its long- term safety measures when used to manage chronic diseases. Enhanced research should investigate DBR's combined therapeutic effects when paired with standard treatments including hydroxyurea therapies and blood transfusions as well as pain control protocols. Low-resource healthcare providers need education and training on how to benefit from DBR use and correct procedures in order to successfully implement DBR clinical practice. Safe and effective use of DBR demands joint work among traditional healers and modern medical professionals with local communities.

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