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Short Communication

Mechanisms and Therapeutic Potential of Gongronema latifolium in Sickle Cell Disease

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Abstract

Abnormal haemoglobin polymerisation, red blood cell deformation, chronic haemolysis, vaso-occlusion, and systemic inflammation are the hallmarks of sickle cell disease (SCD), a genetic hemoglobinopathy. Many patients in developing nations rely on medicinal plants as supplemental therapies despite advancements in management. The tropical medicinal plant Gongronema latifolium Benth., which is commonly used in West Africa, has drawn notice for its haematopoietic, antioxidant, anti-inflammatory, and antisickling qualities. This article examines G. latifolium's pharmacodynamics in relation to sickle cell disease, emphasising its bioactive phytochemicals and modes of action. The plant contains flavonoids, alkaloids, saponins, tannins, and phenolic compounds that can reduce inflammation, improve erythrocyte membrane stability, modulate oxidative stress, and inhibit haemoglobin S polymerisation, according to experimental research. These pharmacodynamic effects imply that G. latifolium might be helpful in sickle cell disease treatment. To confirm its effectiveness, find the best dosage, and create safety profiles for long-term therapeutic use, more clinical trials are needed.

Keywords: oxidative stress; gongronema latifolium; sickle cell disease; pharmacodynamics; antisickling agents; phytochemicals

Introduction

One of the most common genetic diseases in the world, sickle cell disease (SCD) is especially common in sub-Saharan Africa. Haemoglobin S (HbS) is produced when a point mutation in the β-globin gene causes valine to replace glutamic acid at position six of the haemoglobin molecule. Low oxygen tension causes HbS to polymerise, giving erythrocytes a sickled shape and stiffness. These aberrant cells cause organ damage, haemolytic anaemia, vaso-occlusion, and frequent, excruciating crises [1]. Hydroxyurea, blood transfusions, and bone marrow transplants are examples of pharmacological treatments that have improved patient outcomes, but they are costly and difficult to obtain in many low-income nations. As a result, medicinal plants continue to be a significant complementary or alternative treatment for sickle cell disease [2]. Gongronema latifolium, a climbing shrub in the Asclepiadaceae (Apocynaceae) family, is one plant that has garnered growing scientific attention. The plant is widely found throughout tropical Africa, and in Nigeria, it is frequently used as a vegetable and medicinal herb. It has historically been used to treat sickle cell disease, diabetes, hypertension, malaria, and gastrointestinal issues [3]. G. latifolium has been shown to have antioxidant, anti-inflammatory, hepatoprotective, antimicrobial, and antisickling properties in a number of pharmacological studies. Its rich phytochemical composition and capacity to alter several biochemical pathways linked to disease processes are primarily responsible for these therapeutic qualities. This review discusses the pharmacodynamic mechanisms through which G. latifolium may exert beneficial effects in patients with sickle cell disease [4].

Gongronema latifolium's Phytochemical Composition

The bioactive phytochemical components of medicinal plants play a major role in their pharmacological actions. Several classes of secondary metabolites have been found in G. latifolium, according to phytochemical analyses, including:Flavonoids,Alkaloids, Saponins, Tannins, Terpenoids, Phenolic substances and Glycosides [5]. The leaves of G. latifolium are especially rich in phenolic compounds and flavonoids. These substances have potent antioxidant qualities and are essential for preventing oxidative damage to erythrocytes. Additionally, molecular docking studies have predicted that some of the plant's phytochemicals will interact with sickle haemoglobin, indicating potential therapeutic activity against SCD [6].

Sickle Cell Disease Pharmacodynamic Mechanisms

The antisickling activity of G. latifolium is one of its most significant pharmacodynamic characteristics. By preventing haemoglobin polymerisation, antisickling agents stop or reverse red blood cell deformation.

The plant's phytochemicals may interact with haemoglobin molecules to stabilise the oxygenated form of haemoglobin and stop HbS from polymerising in hypoxic environments. This effect enhances blood flow in microcirculation and lessens erythrocyte sickling [7]. G. latifolium is frequently used in polyherbal antisickling formulations used in traditional medicine to treat sickle cell anaemia. Such plant-based formulations have been shown in experiments to affect haematological parameters like haemoglobin levels and red blood cell counts [8].

A key factor in the pathophysiology of sickle cell disease is oxidative stress. Excessive reactive oxygen species (ROS) produced by sickled erythrocytes harm cell membranes and encourage haemolysis.Antioxidant enzyme activities have been demonstrated to be increased by G. latifolium extracts, including: SOD, or superoxide dismutase GPx, or glutathione peroxidase and Reductase of glutathione (GR) In addition, the plant protects against oxidative damage by lowering lipid peroxidation markers like malondialdehyde (MDA). G. latifolium may improve erythrocyte survival and lessen haemolysis in sickle cell patients through these antioxidant mechanisms [9]. Another important component of sickle cell disease is chronic inflammation. Increased expression of adhesion molecules and inflammatory cytokines is linked to vaso-occlusive crises. G. latifolium contains bioactive substances with strong anti-inflammatory properties, especially flavonoids and saponins. These substances block inflammatory mediators like:TNF-α, or tumour necrosis factor-alpha, IL-6, or interleukin-6, NF-κB, or nuclear factor kappa B G. latifolium may lessen vascular inflammation and the frequency of vaso-occlusive episodes by inhibiting inflammatory pathways [10]. The development of sickle cell disease is significantly influenced by the immune system. Research has shown that G. latifolium extracts improve humoral and cellular immune responses. According to experimental data, the plant extract boosts phagocytic activity, increases neutrophil counts, and induces the production of immunoglobulins in animal models. People with sickle cell disease, who are frequently prone to infections, may benefit from this immunomodulatory action by having better host defence mechanisms [11]. The delicate membranes of sickle erythrocytes are easily ruined during circulation. It is thought that some of the phytochemicals in G. latifolium stabilise erythrocyte membranes, which lowers haemolysis.Membrane stabilisation happens via a number of processes, such as:Lipid peroxidation inhibition, improvement of the structural integrity of the membrane defence of membrane proteins [12]. Patients with sickle cell disease may benefit from these effects in terms of better haematological outcomes and red blood cell survival.

Bioavailability and Pharmacokinetics

The information that is currently available indicates that G. latifolium's active compounds are absorbed through the gastrointestinal tract after oral administration, despite the fact that research on its pharmacokinetics is still scarce. Following absorption, these substances have systemic effects via metabolic, anti-inflammatory, and antioxidant pathways [13]. The absorption, distribution, metabolism, and excretion (ADME) profiles of the plant's main bioactive components require additional research.

Implications for Clinical Practice

G. latifolium's pharmacodynamic characteristics imply that the plant may be helpful as an adjunctive treatment for sickle cell disease. Among the possible clinical advantages are: decrease in erythrocyte sickling, Reduced oxidative stress, Enhanced immunity, Decreased inflammation and Increased survival of erythrocytes Medicinal plants like G. latifolium may offer sickle cell disease patients an inexpensive supportive treatment in areas where access to traditional therapies is restricted. Nonetheless, in vitro research and animal models provide the majority of the evidence currently available. To establish standardised dosage regimens and validate its therapeutic potential, rigorous clinical trials involving human subjects are required [14]. G. latifolium extracts are generally safe at moderate doses, according to preclinical toxicological research. However, because strong phytochemicals are present, excessive consumption may have negative effects. Therefore, before the plant is suggested for regular clinical use in sickle cell patients, standardisation of extracts and controlled clinical trials are crucial [15].

Conclusion

With several pharmacodynamic actions pertinent to the treatment of sickle cell disease, Gongronema latifolium is a promising medicinal plant. Its antisickling, antioxidant, anti-inflammatory, immunomodulatory, and membrane-stabilizing qualities imply that it may lessen the consequences of illness and enhance the lives of those who are impacted. More clinical research is required to validate its therapeutic efficacy and create standardised treatment protocols, despite promising experimental evidence. Combining contemporary pharmacological research with traditional medicinal plants like G. latifolium may help create new, reasonably priced sickle cell disease treatments.

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