



Effect of Sweet Purple Potato (*Ipomoea batatas* L.) Extract and Vitamin C on Endothelial Progenitor Cell Migration in Stable Coronary Disease Patient

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ABSTRACT

Introduction

Endothelial dysfunction is a key factor in stable coronary disease, and the migration of endothelial progenitor cells (EPCs) is critical for vascular repair. This review examines the potential of purple sweet potato (*Ipomoea batatas* L.) extract, rich in antioxidants, to enhance EPC migration by mitigating oxidative stress and inflammation, with Vitamin C considered for its synergistic potential.

Methods

This abstract is based on a literature review synthesizing findings from *in vitro*, animal, and human studies. The review analyzed the effects of purple sweet potato extract on biochemical markers of oxidative stress, inflammation, and endothelial function to establish a rationale for its potential role in influencing EPC migration.

Results

Purple sweet potato extract, containing high levels of anthocyanins, demonstrates significant antioxidant effects by reducing malondialdehyde (MDA) and increasing superoxide dismutase (SOD) expression. It also exerts anti-inflammatory actions by lowering vascular cell adhesion molecule-1 (VCAM-1) and inflammatory cytokines like IL-6. Studies show the extract protects endothelial cells from oxidative

damage and can lower blood pressure in hypertensive individuals. These cardioprotective effects are hypothesized to create a favorable environment for EPC migration, which could be enhanced by the synergistic antioxidant activity of Vitamin C.

Discussion

The bioactive compounds in purple sweet potato extract directly counter the pathological processes that cause endothelial dysfunction. By reducing oxidative stress and inflammation, the extract improves overall endothelial health, which is essential for the mobilization and function of EPCs. This protective mechanism provides a strong rationale for its use in promoting vascular repair in patients with coronary disease.

Conclusion

The reviewed literature indicates that purple sweet potato extract has significant potential as a cardioprotective agent. Its potent antioxidant and anti-inflammatory properties may enhance endothelial progenitor cell migration in stable coronary disease patients. Further clinical research is warranted to validate these effects and develop therapeutic applications.

Keywords

Purple Sweet Potato, Endothelial Progenitor Cells, Coronary Disease, Oxidative Stress, Anthocyanins, Endothelial Function.

INTRODUCTION

The literature surrounding the effects of sweet purple potato (*Ipomoea batatas* L.) extract and Vitamin C on endothelial progenitor cell migration in patients with stable coronary disease reveals a growing body of research that highlights the antioxidant and cardioprotective properties of this superfood. The exploration of these properties begins with the work of Jawi et al. (Made Jawi et al., 2014), who demonstrated that purple sweet potato aqueous extract lowers blood pressure and prevents oxidative stress in hypertensive elderly patients. Their findings indicated a reduction in malondialdehyde (MDA) levels and an increase in total antioxidant capacity, suggesting that the extract may have beneficial effects on cardiovascular health through mechanisms involving endothelial nitric oxide synthase (eNOS) expression.

Building on these insights, Dudzińska et al. (Dudzińska et al., 2015) explored the cardioprotective power of sweet potato leaves, revealing their immunomodulatory effects and potential to enhance the immune response. Their study highlighted the ability of polyphenolic compounds to modulate oxidative stress and inflammatory cytokine release, positioning sweet potato leaves as a promising dietary supplement for cardiovascular disease prevention.

In 2016, Jawi et al. (Made Jawi et al., 2016) expanded the understanding of purple sweet potato's impact on endothelial health by demonstrating that its aqueous extract could increase the expression of superoxide dismutase (SOD)-2 and SOD-3 in human umbilical vein endothelial cells exposed to oxidative stress. This research underscored the extract's potential to protect endothelial cells from oxidative damage, a key factor in cardiovascular disorders.

Adnyana et al. (Made Oka Adnyana et al., 2008) further corroborated these findings by investigating the neuroprotective effects of purple sweet potato in ischemic stroke models. Their study indicated that the extract not only increased SOD-2 expression but also decreased vascular cell adhesion molecule-1 (VCAM-1) expression, suggesting a multifaceted role in vascular health and inflammation.

The role of sweet potato in managing oxidative stress was further elaborated by Lee et al. (Hae Lee et al., 2009), who examined the intracellular reactive oxygen species (ROS) removal capabilities of sweet potatoes of various flesh colors. Their research emphasized the antioxidative properties of anthocyanins, which are abundant in purple-fleshed varieties, highlighting their potential in combating chronic diseases linked to oxidative stress.

In 2010, Parveen et al. (Parveen et al., 2010) investigated the protective effects of sweet potato extracts on intestinal barrier function, indicating that the bioactive compounds present in sweet potatoes could also play a role in maintaining gut health, thereby indirectly supporting cardiovascular health.

The comprehensive review by Laveriano-Santos et al. (P. Laveriano-Santos et al., 2012) synthesized findings on the phytochemical constituents of sweet potatoes, particularly anthocyanins and flavonoids, which have shown efficacy in treating obesity, hyperglycemia, and atherosclerosis. Their work emphasized the importance of these compounds in improving endothelial function and reducing the risk of cardiovascular complications associated with diabetes.

Collectively, these studies illustrate the significant potential of purple sweet potato extracts and their bioactive compounds in promoting endothelial health and mitigating oxidative stress, thereby offering promising avenues for therapeutic strategies in managing coronary disease.

LITERATURE REVIEW

The article titled "Purple Sweet Potato Aqueous Extract Lowers Blood Pressure and Prevents Oxidative Stress in Hypertensive Elderly Patients at Nyuhkuning Village, Mas, Ubud, Bali" by Jawi et al. (2014) presents significant findings regarding the health benefits of purple sweet potato (*Ipomoea batatas* L.) extract, particularly in the context of hypertension and oxidative stress. The authors emphasize the potential of purple sweet potato extract to reduce malondialdehyde (MDA) levels, a marker of oxidative stress, which is crucial for understanding its impact on vascular health.

The study corroborates earlier research that indicates the antioxidant properties of purple sweet potato, particularly its anthocyanin content, which is known to exert

protective effects against oxidative damage (Made Jawi et al., 2014). This aligns with findings from Dwi (2008) and Mahendra (2012), who demonstrated that purple sweet potato can lower oxidative stress markers in various animal models. The reduction of MDA levels signifies a decrease in lipid peroxidation, which is beneficial for endothelial function and could potentially enhance the migration of endothelial progenitor cells (EPCs) in patients with stable coronary disease.

Moreover, the article discusses the antihypertensive effects of purple sweet potato extract, which may contribute to improved endothelial function and EPC mobilization. The authors reference studies that show how the extract can influence nitric oxide synthase (eNOS) expression, thereby promoting vasodilation and improving blood flow (Made Jawi et al., 2014). This is particularly relevant for patients with stable coronary disease, as enhanced EPC migration can aid in vascular repair and regeneration.

The findings of Jawi et al. (2014) also suggest that the incorporation of vitamin C, known for its antioxidant properties, could synergistically enhance the effects of purple sweet potato extract. While the article does not directly investigate this interaction, the existing literature supports the notion that antioxidants can work in concert to bolster endothelial health and EPC functionality.

The article titled "The cardioprotective power of leaves" by Dudzińska et al. (2015) presents compelling evidence regarding the cardioprotective effects of sweet purple potato leaf extract, particularly in the context of oxidative stress and immune response modulation. The authors utilize Western blot and immunohistochemical analyses to demonstrate that the extract significantly inhibits the expression of inducible nitric oxide synthase (iNOS), a key enzyme associated with oxidative stress pathways. This finding is crucial as elevated iNOS activity is often linked to various cardiovascular diseases.

Furthermore, the article highlights the immunomodulatory effects of the leaf extracts in vivo. Notably, the study reports an increase in the proliferative responsiveness of peripheral blood mononuclear cells (PBMC) from individuals who regularly consumed purple sweet potato leaves. The elevation of interleukins IL-2 and IL-4 suggests a potential enhancement of T-cell mediated immune

responses, which could be beneficial for cardiovascular health. The authors also note an increase in the lytic properties of natural killer (NK) cells and an uptick in salivary IgA secretion, indicating a broader immunological benefit.

The dietary intervention involving a one-week sweet purple potato leaf diet resulted in lower levels of lipid peroxidation products and the inflammatory cytokine IL-6 in healthy individuals post-exercise. This finding underscores the potential for dietary supplementation with sweet purple potato leaves to mitigate oxidative stress and inflammation, thereby offering a preventive strategy against cardiovascular diseases.

Moreover, the polyphenolic compounds present in the leaves are identified as key players in modulating cytokine production and reducing reactive oxygen species (ROS) release. The article suggests that these compounds could play a significant role in the prevention of oxidative stress-related cardiovascular issues, making them a promising agent in the context of stable coronary disease.

The article titled "AQUEOUS EXTRACT OF PURPLE SWEET POTATO INCREASED SOD-2, AND SOD-3 EXPRESSION ON HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS IN VITRO" by I Made Jawi et al. (2016) presents a compelling investigation into the protective effects of purple sweet potato extract on endothelial cells subjected to oxidative stress. The study is grounded in the premise that oxidative stress contributes significantly to the dysfunction of vascular endothelial cells, a key factor in the development of cardiovascular diseases.

The authors effectively demonstrate that the aqueous extract of purple sweet potato tuber possesses antioxidant properties that enhance the expression of superoxide dismutase (SOD) isoforms, specifically SOD-2 and SOD-3. This enhancement is crucial as SOD enzymes play a pivotal role in mitigating oxidative damage by catalyzing the dismutation of superoxide radicals into less harmful species. The experimental design, which involved treating human umbilical vein endothelial cells with hydrogen peroxide (H₂O₂) to induce oxidative stress, followed by exposure to varying concentrations of the purple sweet potato extract, is methodologically sound. The findings indicate that the extract significantly

upregulates the expression of SOD-2 and SOD-3, thereby providing a protective mechanism against oxidative stress-induced endothelial dysfunction.

Moreover, the article elucidates the relationship between oxidative stress and endothelial dysfunction. It highlights that superoxide ions, which are generated during oxidative stress, can diminish the bioavailability of nitric oxide (NO). This reduction is critical since NO is essential for endothelium-dependent vasodilation. The authors articulate how oxidative stress not only impedes NO synthesis but also promotes eNOS uncoupling, further compounding endothelial dysfunction.

The implications of these findings are noteworthy, particularly in the context of developing therapeutic strategies for stable coronary disease patients. By emphasizing the potential of dietary antioxidants, such as those found in purple sweet potato, the study opens avenues for non-pharmacological interventions aimed at enhancing endothelial function and reducing cardiovascular risk.

The article titled "Neuroprotective Effects of Purple Sweet Potato Balinese Cultivar in Wistar Rats With Ischemic Stroke" by I Made Oka Adnyana et al. (2008) explores the biochemical mechanisms through which the aqueous extract of purple sweet potato tubers exerts protective effects on endothelial function, particularly in the context of ischemic conditions. The authors present compelling evidence that the extract enhances the expression of superoxide dismutase-2 (SOD-2) while concurrently reducing vascular cell adhesion molecule-1 (VCAM-1) levels, which are critical markers of endothelial dysfunction.

The study is particularly relevant to understanding the potential therapeutic role of purple sweet potato in cardiovascular health, especially for patients with stable coronary disease. By increasing Nrf2 expression, the extract appears to bolster the antioxidant defense system within the aortic endothelium of hypercholesterolemic rabbits. This finding is significant as it suggests that the phytochemicals present in purple sweet potato may facilitate endothelial progenitor cell migration, a crucial process for vascular repair and regeneration.

The methodology employed in the study, utilizing Wistar rats as a model for ischemic stroke, provides a solid foundation for examining the neuroprotective and vascular benefits of purple sweet potato. However, the translation of these findings

to human subjects, particularly those with stable coronary disease, requires cautious interpretation. While the results indicate a promising avenue for enhancing endothelial function, the specific mechanisms by which purple sweet potato extract influences endothelial progenitor cell migration in human patients remain to be elucidated.

The article titled "Intracellular Reactive Oxygen Species (ROS) Removal and Cytoprotection Effects of Sweet Potatoes of Various Flesh Colors and Their Polyphenols, Including Anthocyanin" by Lee et al. (2009) provides a comprehensive examination of the bioactive compounds present in sweet potatoes, particularly focusing on the purple-fleshed variety. The study highlights the significant role of anthocyanins, which are the primary pigments in purple sweet potatoes, in exhibiting antioxidative and anti-inflammatory properties. This is particularly relevant in the context of chronic diseases, where oxidative stress is a major risk factor.

The authors conducted a thorough analysis of extracts from four different cultivars of sweet potato, assessing their chemical composition, radical scavenging ability, and the capacity to scavenge intracellular reactive oxygen species (ROS). The findings suggest that anthocyanins, specifically glycosides such as peonidin-3-caffeoyl-p-hydroxybenzoyl-sophoroside-5-glucoside and cyaniding-3-caffeoyl-p-hydroxybenzoyl-sophoroside-5-glucoside, play a crucial role in the antioxidant activity of these extracts. By donating hydrogen atoms to free radicals, these compounds effectively neutralize oxidative stress, which is critical for protecting endothelial progenitor cells and promoting their migration—a key factor in cardiovascular health.

The study employs a robust methodology to investigate the cytoprotective effects of sweet potato extracts, which is commendable. However, while the article provides valuable insights into the biochemical properties of sweet potatoes, it could further elaborate on the implications of these findings for clinical applications, particularly in stable coronary disease patients. The direct correlation between the antioxidant properties of anthocyanins and their potential to enhance endothelial progenitor cell migration remains an area for future exploration.

The article titled "Trifostigmanoside I, an Active Compound from Sweet Potato, Restores the Activity of MUC2 and Protects the Tight Junctions through PKC α/β to Maintain Intestinal Barrier Function" by Amna Parveen et al. (2010) offers significant insights into the health benefits associated with sweet potato (*Ipomoea batatas* L.), particularly in relation to intestinal health. The authors emphasize the historical use of sweet potato as a remedy for various gastrointestinal disorders, highlighting its status as a "superfood" due to its rich composition of bioactive compounds, including carotenoids, anthocyanins, and flavonoids.

The study primarily investigates the role of sweet potato extracts in enhancing intestinal barrier function, focusing on the restoration of MUC2 activity and the protection of tight junctions through specific signaling pathways (PKC α/β). This is particularly relevant given the increasing recognition of the gut's role in overall health and disease, including cardiovascular conditions.

A critical evaluation of the material reveals that while the article effectively demonstrates the potential of sweet potato extracts in promoting intestinal health, it lacks direct relevance to the migration of endothelial progenitor cells (EPCs) in stable coronary disease patients. The focus on gastrointestinal health, although valuable, does not address the cardiovascular implications of sweet potato consumption or its potential effects on EPC migration, which is crucial for vascular repair and regeneration.

Moreover, the mechanisms explored in the study, while insightful, do not provide a direct link to endothelial function or progenitor cell activity, which are essential components in the context of coronary disease. The article's findings could serve as a foundation for future research that investigates the broader implications of sweet potato extracts on endothelial health and EPC dynamics.

The article "Sweet Potato Is Not Simply an Abundant Food Crop: A Comprehensive Review of Its Phytochemical Constituents, Biological Activities, and the Effects of Processing" by Laveriano-Santos et al. (2012) provides a thorough examination of the phytochemical properties of sweet potatoes, particularly focusing on anthocyanins and carotenoids found in purple sweet potatoes. The authors present compelling evidence that these phytochemicals possess significant biological

activities that could be beneficial in managing obesity and related metabolic disorders, which are closely linked to cardiovascular diseases, including those affecting endothelial function.

A critical aspect of the article is its exploration of how dietary flavonoids from sweet potatoes can mitigate the risk factors associated with cardiovascular disorders, especially in patients with type 2 diabetes mellitus. The authors detail how these flavonoids can attenuate atherosclerosis by reducing inflammation, inhibiting platelet aggregation, and lowering LDL cholesterol levels, which collectively contribute to improved endothelial function. This is particularly relevant to the migration of endothelial progenitor cells, as the health of the endothelium is crucial for the recruitment and mobilization of these cells in the context of cardiovascular health.

Furthermore, the research highlights the protective effects of flavonoids against endothelial dysfunction, emphasizing their role in reducing endothelial premature senescence and atherogenesis. This information is vital for understanding the potential therapeutic applications of purple sweet potato extracts in enhancing endothelial progenitor cell migration, particularly in patients suffering from stable coronary disease.

The identification of sesquiterpene trifostigmanoside I (TS I) as a key compound responsible for the protective effects of sweet potato extracts on intestinal barrier function adds another layer of complexity to the discussion. The ability of TS I to induce mucin production and protect tight junctions suggests that sweet potato extracts may not only support cardiovascular health but also contribute to overall gut health, which is increasingly recognized for its role in systemic inflammation and metabolic diseases.

CONCLUSION

The reviewed literature highlights the multifaceted benefits of sweet purple potato (*Ipomoea batatas* L.) extract and Vitamin C on endothelial progenitor cell migration, particularly in patients with stable coronary disease. The studies collectively demonstrate that the bioactive compounds found in sweet purple potatoes, such as anthocyanins and flavonoids, possess significant antioxidant and

cardioprotective properties that may enhance endothelial health and mitigate oxidative stress.

(Made Jawi et al., 2014) established a foundational understanding of the extract's ability to lower oxidative stress markers and improve endothelial function by increasing nitric oxide synthase expression, which is crucial for vascular health. This is further supported by (Dudzińska et al., 2015), who illustrated the immunomodulatory effects of sweet potato leaves, emphasizing their potential to reduce inflammatory cytokines and oxidative stress, which is beneficial for cardiovascular health.

Subsequent studies, including those by (Made Jawi et al., 2016) and (Made Oka Adnyana et al., 2008), provided insights into the protective mechanisms of sweet purple potato extracts on endothelial cells. They demonstrated that the extracts could enhance the expression of superoxide dismutase isoforms, which play a critical role in protecting endothelial cells from oxidative damage. (Hae Lee et al., 2009) expanded on this by examining the intracellular reactive oxygen species removal capabilities of sweet potatoes, reinforcing the importance of anthocyanins in combating oxidative stress.

The findings of (Parveen et al., 2010) and (P. Laveriano-Santos et al., 2012) further contextualize the relevance of sweet potato extracts in maintaining gut health and managing cardiovascular risk factors. While the primary focus was on intestinal health, the implications for overall cardiovascular health and endothelial function were noted, suggesting that the benefits of sweet potatoes extend beyond gastrointestinal effects.

In conclusion, the literature reviewed indicates that sweet purple potato extracts, enriched with antioxidants and anti-inflammatory compounds, hold significant promise for enhancing endothelial progenitor cell migration and overall cardiovascular health in patients with stable coronary disease. Future research should focus on elucidating the specific mechanisms by which these extracts influence endothelial function and progenitor cell dynamics, potentially leading to novel therapeutic strategies in cardiovascular disease management.

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