



# Improving Platelet Mitochondrial Function with Natural Plant-Derived Compounds

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## DESCRIPTION

Platelets, small cell fragments in the blood, play an essential role in wound healing and preventing excessive blood loss through clot formation. Beyond this well-known function, platelets also reflect the overall health of the body, as their bioenergetic state can reveal metabolic and mitochondrial health. Bioenergetics the process by which cells produce and utilize energy determines platelets' ability to function correctly. Disruptions in platelet bioenergetics can contribute to various health issues, including cardiovascular diseases and inflammation. Recent research has highlighted the potential of plant-derived compounds in normalizing platelet bioenergetics, offering a natural approach to maintaining platelet health and function.

Bioenergetics in platelets primarily involves processes within the mitochondria, the cell's powerhouse. Mitochondria convert nutrients into Adenosine Triphosphate (ATP), the energy molecule that fuels cellular activities. For platelets, ATP production supports their activation, aggregation and adherence to blood vessel walls functions that are vital for proper clot formation. When platelets detect an injury site, they change shape, adhere to the damaged vessel and release signaling molecules that attract more platelets, leading to clot formation.

Platelet bioenergetics can be assessed by examining oxygen consumption rates and ATP production levels, both of which are indicators of mitochondrial activity. When platelets are unable to generate sufficient ATP, their ability to perform critical functions diminishes, leading to an impaired response to vascular injury. Dysregulated platelet bioenergetics has been associated with chronic conditions such as diabetes, metabolic syndrome and cardiovascular diseases, where mitochondria struggle to maintain normal energy production due to oxidative stress or inflammation.

Plant-derived compounds, particularly polyphenols, flavonoids, terpenes and alkaloids, have gained attention for their positive impact on cellular health, including bioenergetic functions. These natural compounds exhibit a range of bioactivities that

can influence mitochondrial health, combat oxidative stress and improve energy production. Due to their antioxidant properties, plant-derived compounds help reduce oxidative damage, a common issue in cells with high metabolic rates, like platelets. By doing so, they support the bioenergetic health of platelets and may reduce the risk of conditions linked to dysfunctional platelets.

Several plant compounds have demonstrated the ability to influence platelet bioenergetics through mechanisms that include enhancing mitochondrial efficiency, reducing oxidative stress and modulating metabolic pathways.

Polyphenols, found in foods like berries, green tea and grapes, are well-known for their antioxidant activity. Specific polyphenols such as resveratrol, quercetin and catechins have shown beneficial effects on mitochondrial function. Resveratrol, found in grapes and red wine, has been shown to improve mitochondrial efficiency by activating sirtuins, proteins that regulate cellular health. Quercetin, abundant in apples and onions, reduces oxidative damage in platelets by scavenging free radicals, thereby protecting mitochondrial integrity. Catechins, present in green tea, enhance mitochondrial function by promoting the production of ATP.

Flavonoids, another category of polyphenolic compounds, are present in citrus fruits, dark chocolate and various vegetables. These compounds not only provide antioxidant benefits but also improve platelet mitochondrial function by increasing mitochondrial biogenesis. Flavonoids such as hesperidin and kaempferol contribute to better energy regulation within platelets, promoting their functional stability. Hesperidin, a flavonoid in oranges, supports mitochondrial health by reducing inflammation markers, which are known to disrupt bioenergetic stability.

Terpenes, a large class of compounds found in herbs, spices and citrus fruits, have also been associated with improved mitochondrial function. One terpene, limonene, is found in citrus peels and has shown protective effects against oxidative

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stress. Terpenes like curcumin, the active ingredient in turmeric, provide anti-inflammatory benefits, reducing inflammation that can otherwise interfere with platelet bioenergetics. Curcumin also promotes mitochondrial efficiency by protecting mitochondrial membranes from lipid peroxidation, a process that impairs ATP production.

Alkaloids are nitrogen-containing compounds found in plants such as coffee, cocoa and some herbs. One prominent alkaloid, berberine, found in goldenseal and barberry, has been shown to stabilize platelet bioenergetics by enhancing the efficiency of ATP production and modulating glucose metabolism. Berberine activates Adenosine monophosphate (AMP)-activated Protein Kinase (AMPK), an enzyme involved in energy regulation, thus supporting ATP production and ensuring platelets have an adequate energy supply for proper function.

One of the primary mechanisms by which plant-derived compounds support platelet bioenergetics is through antioxidant protection. Platelets are susceptible to oxidative damage due to their active metabolic processes and exposure to high levels of Reactive Oxygen Species (ROS). Plant compounds

with antioxidant properties neutralize these free radicals, protecting mitochondria from oxidative stress and preserving their ability to generate ATP efficiently.

Mitochondrial biogenesis, the process of producing new mitochondria, is essential for maintaining cellular energy levels. Some plant-derived compounds activate pathways that encourage mitochondrial biogenesis, allowing platelets to sustain energy production even under stress. By supporting the formation of new mitochondria, these compounds enable platelets to maintain bioenergetic resilience and meet the demands of cellular functions.

Chronic inflammation can compromise platelet bioenergetics, as inflammatory mediators disrupt mitochondrial function and increase oxidative stress. Plant-derived compounds with anti-inflammatory effects, such as curcumin and resveratrol, help mitigate these effects, preserving mitochondrial health and ensuring steady ATP production. By reducing inflammation, these compounds allow platelets to operate in an environment that supports bioenergetic stability.