

THE ROLE OF FLAVONOIDS IN DARK CHOCOLATES IN REDUCING VENOUS THROMBOSIS

Isha Jayakumar (1), Shruti Sunil (1), Atul Laddu (1), Jawed Fareed (2), 1 = Global Thrombosis Forum, Suwanee, GA, 2 = Loyola University, Maywood, IL

INTRODUCTION

Venous thrombosis accounts for half of all mortality in the U.S. Flavonoids can stop blood coagulation pathways and regulate key processes involved in thrombosis, including platelet aggregation, fibrinolysis, and nitric oxide production.

Flavonoids are plant derived compounds that show potential in prevention as well as treatment of venous thrombosis. Key flavanols like quercetin and kaempferol are abundant in vegetables, while flavan-3-ols (catechins) are prominent in tea, dark chocolate, and fruits, supporting heart health and providing anti-inflammatory benefits. Flavan-3-ols possess antioxidant, anti-inflammatory, and antiplatelet properties.

The anti-thrombotic actions of cocoa and dark chocolate have been attributed mainly to the high levels of flavan-3-ols. Anti-platelet agents act on the coagulation cascade by inhibiting platelet activation, secretion, and aggregation (Fig. 1). They act by modifying pathways such as blocking thromboxane A₂ (TxA₂) signals, reducing tissue factor expression and improving nitric oxide production, thus promoting blood flow and preventing unwanted clots. Disruption of this balance between the antiplatelet agents and coagulation cascade increases the risk of venous thrombosis and thrombotic events such as heart attacks and strokes.

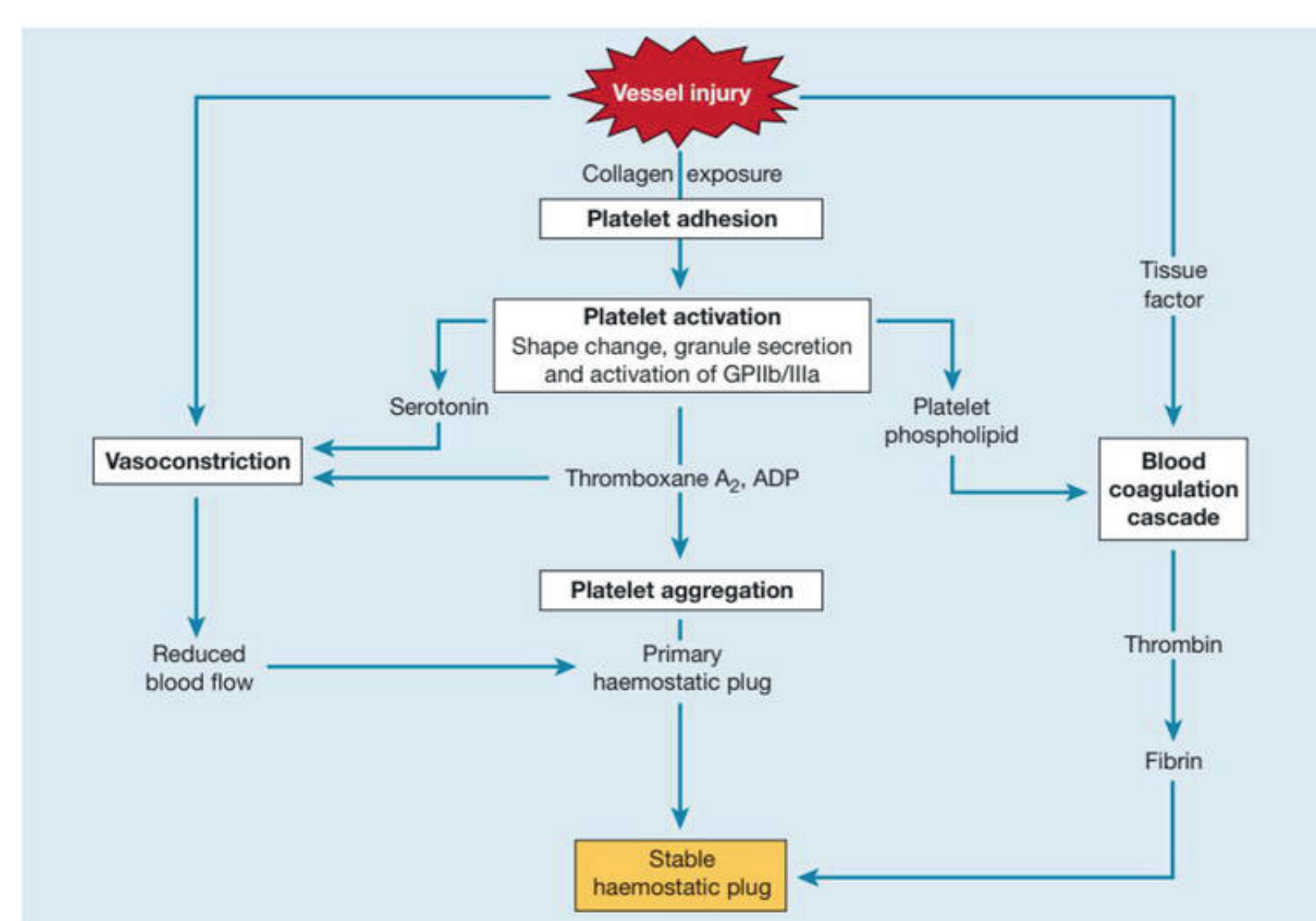


Figure 1: Platelets and blood coagulation

METHODS

We evaluated the beneficial role of flavonoids present in dark chocolate in the prevention of venous thrombosis by researching published literature across multiple sources.

RESULTS

Dark chocolate with high cocoa content has a high concentration of flavan-3-ols that exhibit antiplatelet effects. Flavan-3-ols block platelet activity through multiple pathways, inhibiting the arachidonic acid pathway and binding to thromboxane A₂. These flavonoids reduce reactive oxygen species levels, platelet aggregation and prothrombotic effects (Figure 2).

Platelet hyperactivation contributes significantly to heart attacks and other cardiovascular diseases. Cocoa flavanol consumption significantly decreased P-selectin expression, a marker of platelet activation, and reduced ADP-induced and collagen-triggered platelet aggregation ($p < 0.05$). Ostertag et al in a randomized trial found that flavan-3-ol-enriched dark chocolate noticeably decreased ADP-induced platelet aggregation and P-selectin expression in men but reduced thrombin receptor-activating peptide-induced platelet aggregation in women (Figure 3).

Antiplatelet effects of dark chocolates are primarily attributed to its ability to enhance nitric oxide bioavailability, which relaxes blood vessels and stops platelets from sticking together. Flavanols block phospholipases and NADPH oxidase, which contribute to blood clotting and reduce oxidative stress and the damage caused by harmful molecules.

Cocoa flavanols may help reduce the risk of thrombotic events by inhibiting excessive clotting. Katz et al. in a modeling study estimated that daily consumption of dark chocolate with a high cocoa content might prevent 85 cardiovascular events per 10,000 population treated over a 10-year period (Figure 4).

FUTURE DIRECTIONS

1. Cardiovascular Benefits of dark chocolate, ability to reduce blood pressure, improve arterial function, and enhance lipid profiles by increasing HDL.
2. The antioxidant properties of cocoa polyphenols, which contribute to improved endothelial function and reduced oxidative stress, will also be a critical area of study, especially in populations under significant oxidative stress.
3. The role of dark chocolate in modulating the immune system and its potential protective effects against diseases such as Alzheimer's, Parkinson's, and certain cancers.
4. Refining the manufacturing process of dark chocolate, including tempering and conching.

CONCLUSIONS

Platelet hyperactivation contributes significantly to heart attacks and other cardiovascular diseases. Dark chocolate, through its unusually high flavan-3-ol content, inhibits excessive platelet aggregation and clot formation. Although additional well-controlled studies examining dietary sources and cardiovascular outcomes are warranted, current evidence supports moderate consumption of flavonoid-rich foods.

Dark chocolate: ~20-30 g/day (1 small square or 1 oz) with 70% cocoa content, preferably unsweetened or low-sugar, provides beneficial flavonoids without excessive added sugars or calories. Cocoa: 1-2 cups/day of natural (non-alkalized) cocoa retains higher flavonoid content than Dutch-processed cocoa. Coffee: 1-3 cups/day, ideally black or lightly sweetened, contributes polyphenols that may support cardiovascular health; excessive sugar and cream should be avoided.

Our message is simple: Unsweetened dark chocolate with high cocoa content is your friend when consumed in moderation. Try it; you will like it. You will thank it.

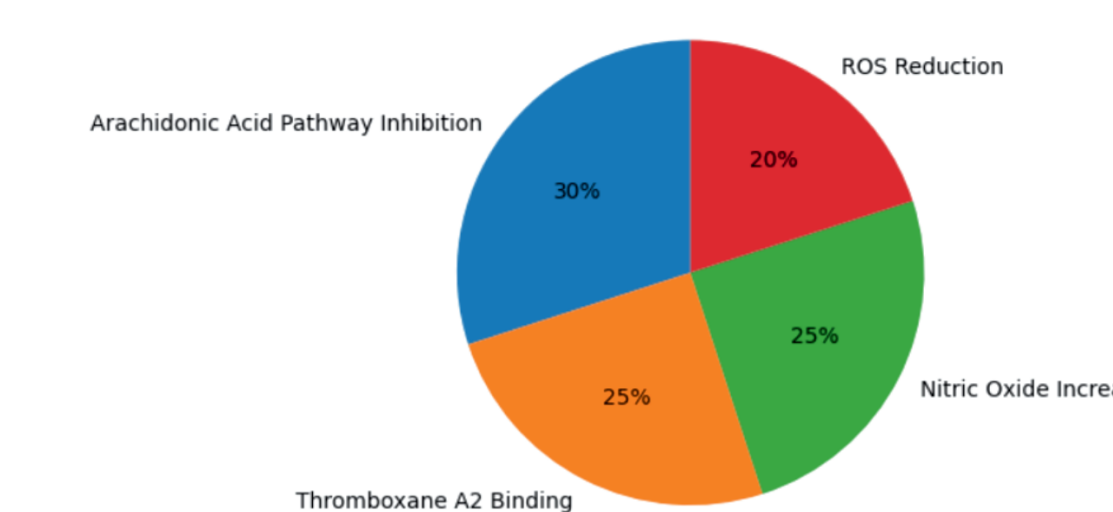


Figure 2: Mechanisms Behind Dark Chocolate Antiplatelet Effects

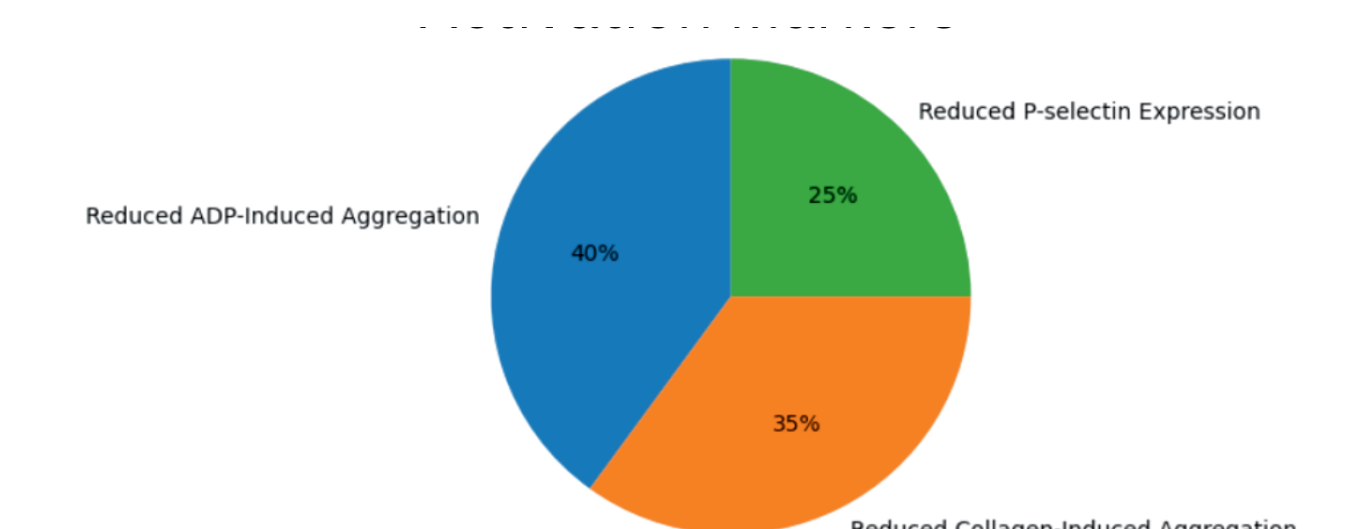


Figure 3: Observed Reductions in Platelet Activation Markers

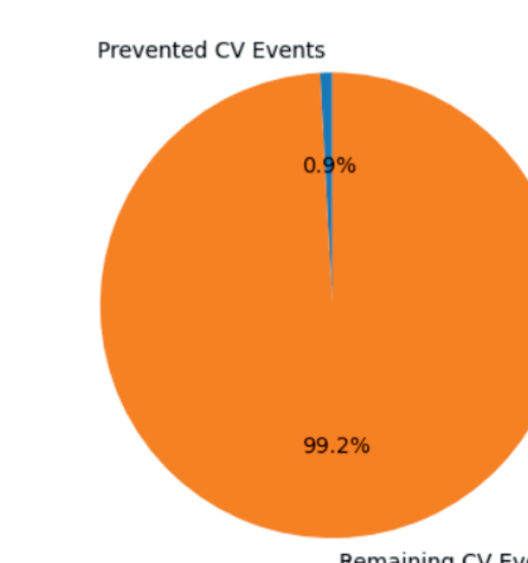


Figure 4: Modeled Impact of Daily Dark Chocolate Consumption on CV Events